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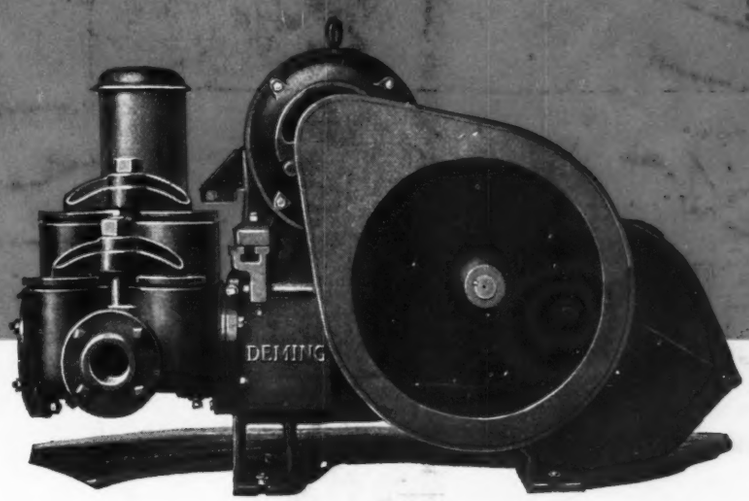

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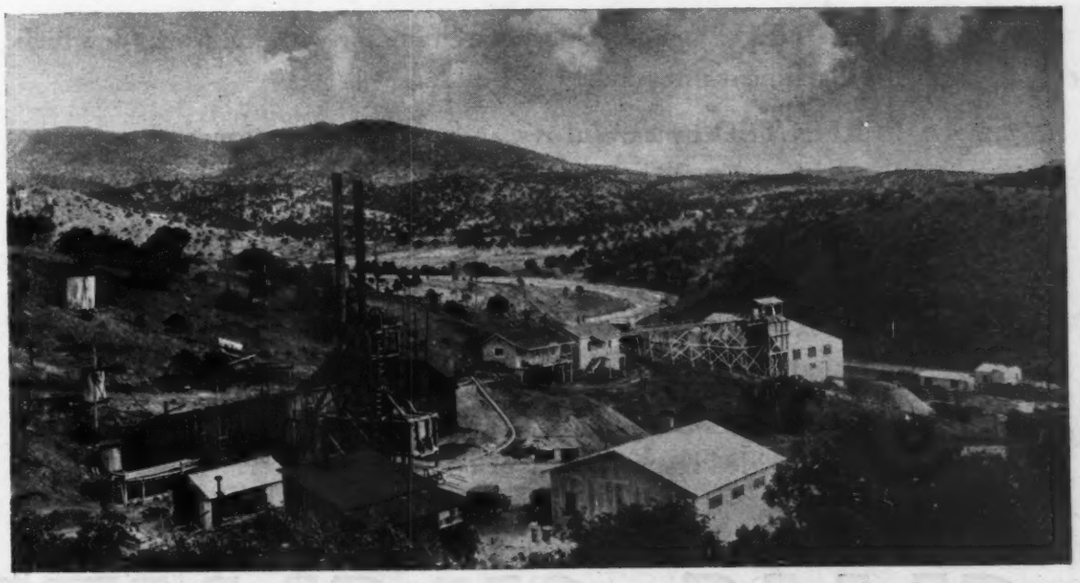

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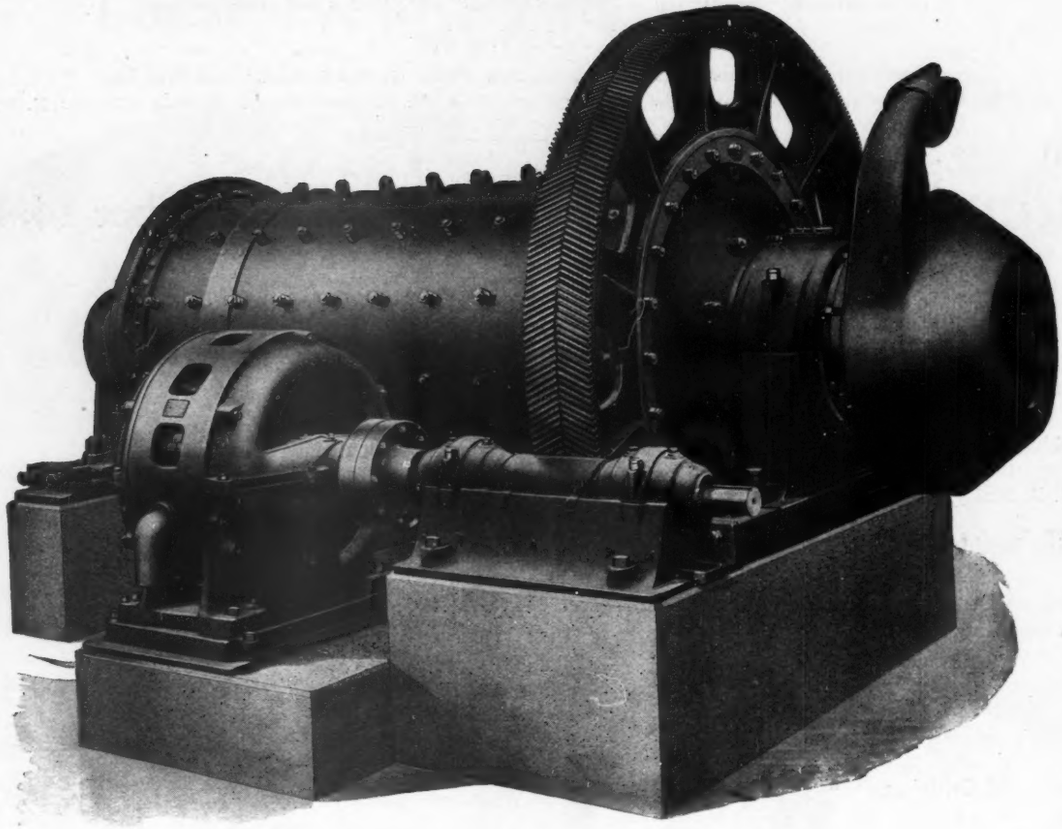

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Human Interest Shifts From Politics to Economics

SPEAKING at Southampton, Long Island, recently, Dr. Nicholas Murray Butler made a plea for constructive and far-seeing statemanship in attacking the tariff problem of the United States. "This is no time," he said, "to listen to the selfish pleas of paid lobbyists or to permit log-rolling combinations of special interests to use public authority for their own benefit in disregard for the far greater interest of the whole people of the United States. In short, a tariff formulated in the year 1929 with an eye single to the public interest, and in accordance with the historic principles of American fiscal policy, will be something very different from that now reported in the public press as likely to be urged for enactment into law."

Inevitable groupings of interests outside the United States are taking place. This trend does not forecast commercial or racial antagonisms, but rather the reverse. A United States of Europe should pave the way for a reduction in the number of boundary disputes and lead to the attainment of a more peaceful progress. "Given a coherent, reasonable, well-administered economic union," Doctor Butler maintains, "there would appear to be no reason why the same conditions of high wages, mass production, cheap and quick communication, and installment buying, which prevail throughout that free trade area which is the United States, should not quickly come to prevail throughout another free trade area, which would be the economic union of the United States of Europe."

Assuming the consummation of the United States of Europe, a lesser task would be the cementing of economics relations within the British Commonwealth of Nations. The third great economic union would be the United States of America. Then would world unity of aim be easier of accomplishment. But the pressing question of the hour is the attitude to be taken by the United States. "What are we going to do about it?" asks Doctor Butler. "Where shall our influence be thrown? Shall it be for a repetition of the old stupidities, the old ignorances and the old antagonisms, or shall it be for a new world-order in which selfish competition shall be supplanted by kindly and large-minded co-operation? That is in substance the crucial questions which at this moment awaits answer by leaders of opinion in every land."

Racial Assimilation, and the American Melting Pot

EMPLOYMENT PROBLEMS are not new to the West. In its early days a large quantity of cheap labor was necessary for the development of territory then suffering under the handicap of exorbitant transportation costs, and an influx of an undesirable type of Orientals resulted. Later it was realized that the low standards of living of these immigrants threatened to affect seriously the economic growth of the entire section, so a stringent immigration law directed against Chinese and Japanese laborers had to be put into force. This dispelled the Oriental threat, but other problems remained.

In the Southwest, the presence of communities of Mexicans, unorientated to our customs and unwilling to adopt them, has occasionally evoked protests from labor organizations. In an article in *The New Republic*, Mr. R. N. McLean points out that there are more Mexicans in California, Arizona, New Mexico, and Texas than there are in northern Mexico, and that the number is growing rapidly. He insists that we cannot continue to permit unlimited numbers to settle in the Southwest—retaining the language, customs, and standards of living of Mexico—without throwing many of our own workers into unemployment. No burden is harder to carry than that of unemployed workers, as our British friends across the Atlantic have discovered.

For several years, bills have been introduced into Congress with the object of applying the immigration quota to Mexicans as well as to Europeans and Asiatics. Consideration of all the factors involved, however, indicates that such a step might disrupt the operation of many Southwestern industries, among the most important of which are copper mining and smelting—dependent on a steady supply of Mexican labor to perform unskilled work for which wages high enough to attract American laborers are not customarily paid. The tender susceptibilities of our Latin neighbors must also be considered. To discriminate against Mexico alone among the Latin American nations might well cause trouble. By excluding our trained technicians, Mexico could wreak havoc

with our extensive interests within her borders. Our relations with that unfortunate country have been on a very precarious footing for many years, and to run the risk of straining them further by an unwise or unnecessary move would be stupid.

As a remedy for the situation, Mr. McLean suggests the appointment of an international commission, the members of which would represent both countries, to study the question with particular reference to the capacity of United States industry to absorb Mexican workers. The Mexican government, he thinks, might issue passports only to those of its citizens who are guaranteed employment in the United States.

To the north of the line, opportunity also exists for improvement. The United States has long been considered as a great melting pot of all peoples. Any group that remains alien and distinct—as the Mexicans do—makes the task of government doubly difficult. Resident Mexicans must be encouraged to become naturalized and to bear their share of government. Mining companies, through their company settlements, libraries, schools, and stores, can do much to hasten the process of assimilation. No question of standardization, of reducing every citizen to the status of a pea in the great American pod, is involved. The question is merely one of adaptation to the surrounding civilization. If the mining industry can do aught to hasten it, so much the better.

California Mineral Producers Recognize Need for Organization

A DETERMINED EFFORT is to be made in the near future by producers of minerals in California other than petroleum to form an effective organization that will protect the industry from unwise legislation, operate to bring the miner's problems before the public, and achieve among the individual components of the industry a better understanding of the more general problems that confront producers.

Petroleum producers in California are organized. So large and so important is this branch of mining, and so influential is the Oil Producers' Association, that few problems of the industry escape publicity. Effective cooperation safeguards it from most of the unwise legislation that biennially comes from the law mills. California agricultural interests are also organized. Their concerted voice is listened to with respect, and consideration is given by governmental officers to their real or fancied needs.

The miners have the California Metal and Mineral Producers' Association, but this has chiefly espoused the cause of the gold miners. It has raised its voice in the wilderness, but it has lacked the force that a united mineral industry could command. The unreasonably high rates of industrial compensation insurance have been attacked, and it has opposed burdensome legislation. But what has always been needed is the full representation of scattered mining interests.

A great deal can be accomplished by a united front. The non-metallic mineral producers, and the producers of structural materials derived from natural deposits, have much in common with the metal miners. The smaller mining companies are likewise part of the picture. Individual producers must be brought together under effective leadership. The framework of an organization exists. It needs the outer walls and the cement of whole-souled co-operation to form a powerful and an effective structure.

The Northern California Miners' Association and the mining department of the Sacramento Chamber of Commerce are directing special efforts toward building a representative organization. Such initiative is highly commendable.

An Unprecedented Situation in Copper

COMMENTATORS on industrial matters predicate their conclusions, as to the condition of business, on the trade barometers of commodity sales. No better yardstick for this purpose has been evolved. Application of the formula to the copper market affords evidence welcome to the optimist. In the week ended on September 4 (the metals' week ends on Wednesday, at 4 p.m.) domestic and foreign sales of copper totaled 120,000 tons, a record for all time. The end of a "buyers' strike," reported to have been inspired in London, is held responsible for the flood of orders; and despite the disorganization, especially abroad, caused by the runaway market of last spring, when the metal reached 24 cents, an increase or persistence in the abnormal demand may have the effect of pegging the price, for a time, at least, slightly higher than the recently current quotation of 18 cents.

Violent fluctuations in the cost of essential goods are inevitably reflected in industrial uncertainties and hesitancy. Buyers who act concertedly to depress a price that indicates no excessive profit to the producer, much less an exploitation of the consumer, are likely to be hoist on their own petard.

Employee Participation in Production Profits

THE favorable condition in which American labor finds itself today is shown by the data on wages recently made available by the United States Census Bureau. In groups for which information is available the average yearly wage received per employee in 1927 was about $1,285, as against $1,164 in 1919—an increase of 10.4 per cent. This appreciation is even more striking when one remembers that the cost of living in the United States since the war has declined 6 per cent, being now 21 per cent under the peak reached in 1920. In other words, not only does the average employee receive substantially higher wages than he did eight years ago, but his buying power per unit of currency has materially increased.

Another significant fact developed by these figures is that in 1927 the average employee added $3,060 to the

value of the raw material used in manufacture, whereas in 1919 the increment was only $2,750. By reason of more efficient machinery, better organization, more intelligent workmanship over this period, each employee has increased the value of a manufactured article from a given raw material.

One of the basic reasons for this increased value of products produced per employee and resulting in increased wages per employee is the materially increased use of power per employee. In 1927, according to incomplete figures, a total of 5.33 horsepower was installed per employee as against 3.26 horsepower in 1919, or an increase of about 64 per cent in the use of power per employee in manufacturing plants.

Although these data apply principally to the manufacturing industries, the influence for good permeates the entire economic structure. The American laborer has had a fair share in the financial outcome. He has increased the productive value of his services by 11.2 per cent, and his employer has in return increased wages by 10.4 per cent, despite a lowering cost of living. Labor has shared in the increased profit to the enterprise—an economic tendency in the United States that might well be adopted to a larger extent by the industries of other countries.

Utilizing Low-Grade Chrome Ores

EARLY LAST YEAR this publication urged that attention be paid to the possibility of improving technique of treatment of chrome ore in the production of chromium compounds. It pointed out that the recovery of bichromate, used largely in the leather industries and finding increased application elsewhere, involves fine grinding prior to roasting, and the lixiviation of the mass. Opportunity for improvement and economies would seem to lie in the direction of a more efficient leaching process and a higher recovery of the valuable constituent by the application of modern methods of solution displacement and the progressive enrichment of leach liquors. The expense involved in evaporation under existing conditions might be avoided, in part at least, and attention should be paid to more economical and more automatic methods of crystallization and the recovery of heat.

Such research, as *Engineering and Mining Journal* has pointed out before, should make possible the utilization of ores of a lower grade than those considered suitable at present. At least, such research should indicate how lower-grade material may be concentrated and beneficiated in the event of national emergency. Chromium ores to be found within the borders of the United States are suitable for the production of chromium compounds, as was proved during the war. What is needed is the injection of engineering initiative and experience into the problems of treatment, to demonstrate to those responsible for the production of chemical compounds from metallic ores that technical advance, economical processing, and high extraction invariably follow the result of research on low-grade ores. The preference for high-grade ore shown today by manufacturers is merely a natural preference that has been in evidence in every industry using and processing raw material. Efficient recovery and low-cost production are seldom achieved, nor are their possibilities gaged, until lean material only is available.

Engineering and Mining Journal is particularly pleased to note, therefore, that its suggestions have been heeded, and that a study of the chemical methods used in the treatment of chrome ore has been started by the United States Bureau of Mines, in co-operation with the University of Nevada. The work, to be done at the Reno Experiment Station, is described "as a phase of a general investigation of methods by which domestic deposits of chromium ores may be utilized in composition with foreign supplies if possible, but primarily as an emergency reserve in case of shortage and high prices resulting from war or foreign monopoly."

Investigations of this character are highly desirable, even if they only result in the uncovering and dissemination of data as to prevailing conditions and customary methods. At present the technique of processing chrome ore is little known and little understood. To repeat what was maintained in these columns recently: The chemical industries have borrowed freely from equipment developed by the metallurgist, but many instances might be cited that indicate a deficiency in engineering acumen in the determination of a chemical method for the application for a chemical process. The metallurgist has contributed materially to the advancement of technology in recent years, but his work, of immense national importance, has been thrown into the background of obscurity, so far as the general public knows, because of costly and elaborate propaganda, flooding the non-technical press, that deflects major public attention in the direction of the achievements of the chemist.

If the metallurgist will penetrate a little more boldly into the domain of chemical engineering, into the field of production of metallic compounds, he will find many opportunities for the exercise of those abilities that have had so potent an influence in effecting a cheap and efficient recovery of metals from low-grade ores.

A New Mechanical Aid to Mining Operations

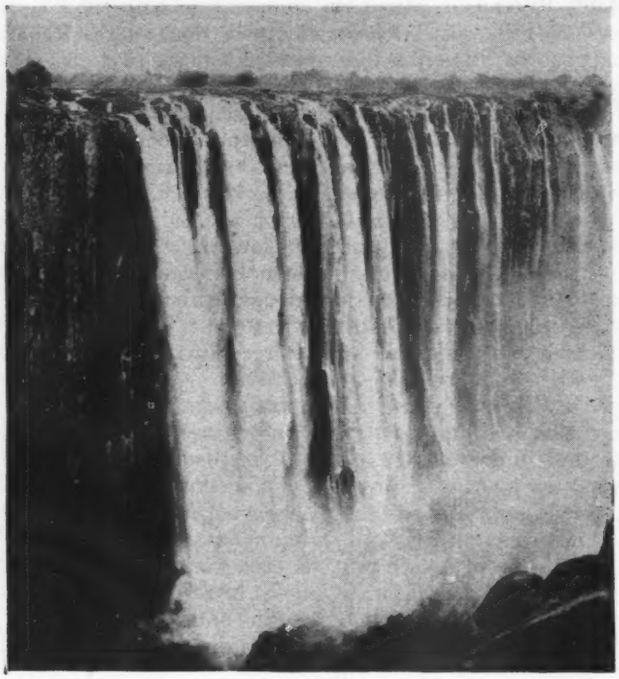
TO CONSIDER in these columns all the new mechanical developments pertinent to the mining industry would obviously be impossible and undesirable. Occasionally, however, an instrument is placed on the market that makes such consideration unavoidable if readers' interests are to be adequately served. In this category is a portable gasoline-powered hammer of the hand-held type, weighing only eighty-seven pounds and striking one thousand blows per minute.

The device, which may be equipped with any $1\frac{1}{8}$-in. tool, is especially adapted to breaking concrete, driving sheeting, digging frozen ground, and tamping. It is said to operate on two gallons of gasoline and one pint of oil per day, is self-lubricating and cooling, and in operation is independent of weather conditions. Easily dismantled and reassembled, free from condensation annoyances, and of sturdy construction, this new mechanical aid will undoubtedly find application in the mining industry, as well as in those fields for which it was specifically designed.

An Untapped Source of

With Geological Notes on the Genesis and Future of Victoria Falls Chasm, Zambezi River, Southern Rhodesia.

Photographs by the Editor



Main Falls, of Victoria Falls, between Buka Island and Livingstone Island

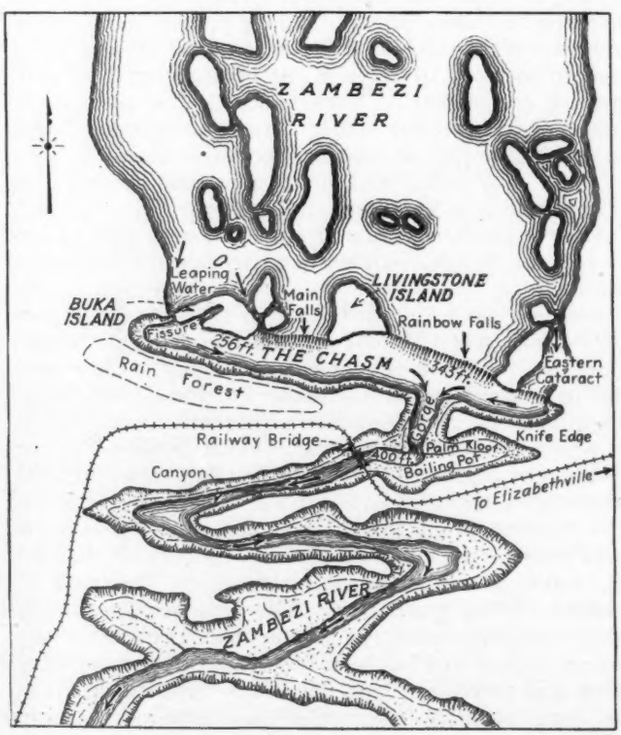
AN AREA of about ten square miles around Victoria Falls was mapped by the director of the Geological Survey of Southern Rhodesia in 1928. In his report for that year he states that the Upper Karoo basalt lavas were found to be dipping at low angles to the east-southeast, this dip accounting for several features which had hitherto been somewhat puzzling. Eight separate lavas were recognized, and by tracing the amygdaloidal bands, it is possible to show that the second and fifth gorges are eroded along faults, which displaced the lavas about 150 ft. The mapping indicates that the bright red Kalahari sand formerly spread over what is now the bed of the Zambezi River, and also over the ground in which the gorge has since been eroded. Thus desert conditions prevailed here at the end of Tertiary times, shortly before man of the Early Stone Age arrived in the district. The old terrace gravel, now at a height of 10 to 25 ft. above the river, is shown by the mapping to be a gravel of the Zambezi River, though slightly rearranged in places by small tributaries when formerly in flood. Implements of the Early Stone Age found in this gravel are sometimes waterworn, but those of the Middle Stone Age are not. The old bed of the Zambezi River, which was in use before the gorge had been cut back to within a mile of the present site of the Victoria Falls, is easily distinguished on the spurs projecting between the windings of the gorge by the smoothed basalt surface and by patches of shingle containing well-rolled implements of the Middle Stone Age. Evidence shows that the fifth gorge was not cut out before the end of the Middle Stone Age. How much farther down the valley the falls were then situated remains to be discovered. After this period, about the time that the third gorge was being eroded and before the present afforestation of the country occurred, a certain amount of redistribution of the Kalahari sand took place by wind action. The sand was deposited on the old terrace gravel and on the old river-bed gravel.

Windings of the gorge downstream from the Victoria Falls were first shown to be caused by river-erosion, and later to the river following "shatter-belts," characterized mainly by a close parallel jointing and to some extent by opened joints filled by calcite veins or by breccia. Detailed mapping of the lavas has indicated that the shatter-belts along the line of the second and fifth gorges are also faults with a noticeable throw. The mode of erosion of the gorge may best be understood by studying the erosion now in progress.

First, photographs taken in 1905 and 1906 show that no marked recession of the lip of Victoria Falls has taken place in 22 years.

Second, the only place where the lip of the falls has

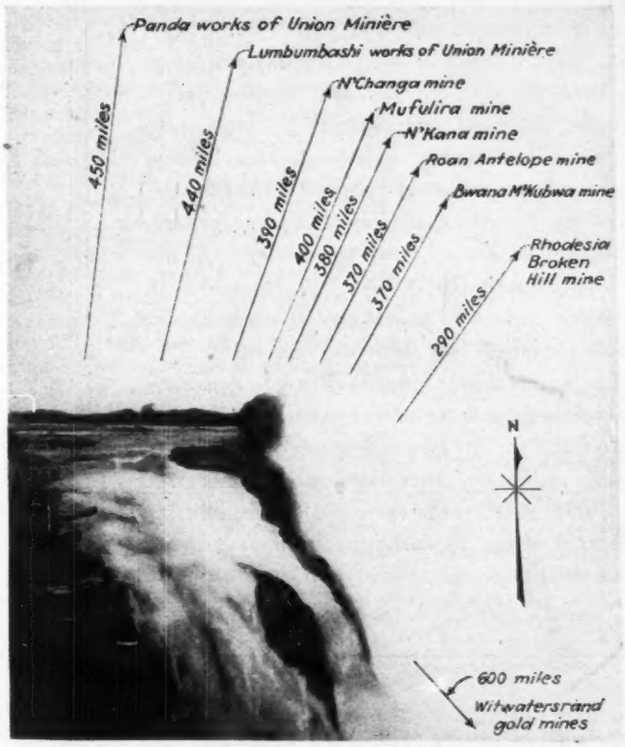
Plan of Victoria Falls



Power for African Mines

given way is at the western cataract. The more the erosion here, the more will water be taken from the rest of the falls, the result being the formation of a longitudinal gorge similar to the Boiling Pot gorge connecting the first and second gorges. This will cut back until a transverse shatter-belt is encountered, when the falls might then open out again along this shatter-belt.

Third, Cataract Island is almost cut in two by a cleft eroded along a zone of close jointing which strikes parallel with the second gorge. At present river erosion is in progress here only when the river is in flood, but



Approximate air-line distances from Victoria Falls to principal mines to the North and to Witwatersrand gold mines

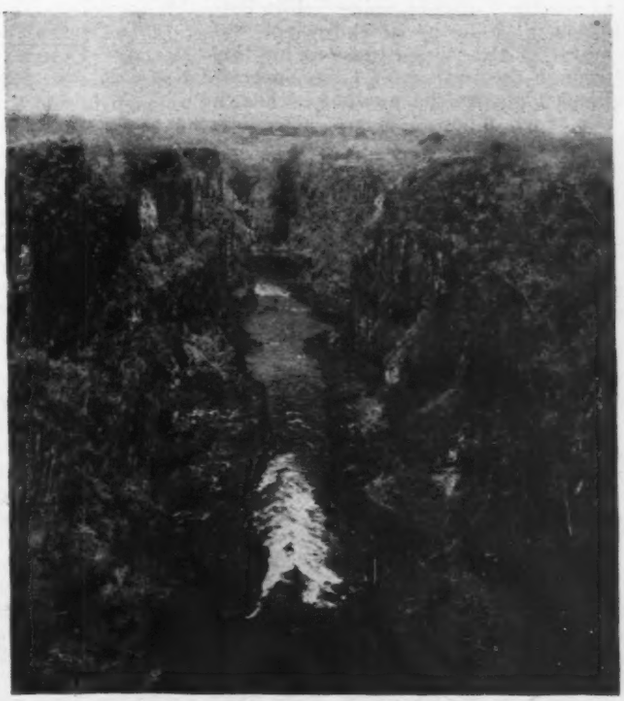
should it take place rapidly it is obvious that another gorge will be cut out parallel to the second gorge and that the present line of falls will be abandoned. Aerial photographs show clearly two lines of weakness radiating from this cleft. One with a direction N. 105 deg. E. cuts through Livingstone Island, whereas the other trends N. 65 deg. E., touching the southern ends of a numerous group of islands.

The future of the Victoria Falls is apparently in the balance, and depends on whether the erosion of the western cataract or the excavation of the cleft on Cataract Island gains the mastery. The shape of the lip of the gorge on either side of the Rain Forest spur indicates that the southern lip of the spur has been molded and that this lip marks a former site of the falls. The same applies to the narrow spur between the second and third gorges. Farther downstream the distinction

Railroad bridge over the Zambezi River at Victoria Falls

becomes less and less clear, owing to later meteoric erosion, but five more older sites where the falls halted for a time have been found. Including the present site, eight positions may be recognized where the Victoria Falls were situated for a time in their retrocession and brought about the opening up of transverse gorges. Evidently, the Victoria Falls have not retrocessed uniformly, but by saltations. On the evidence of the water-worn stone implements, the genesis of the oldest site recognized is not earlier than the Middle Stone Age of South Africa.

Looking down the canyon from the railroad bridge at Victoria Falls



THE MINING INDUSTRY AS A

An essay of philosophy and fact, wherein a distinguished mining engineer describes the transition that has occurred, over a long period of years, in his mental attitude toward what are considered the earmarks of a successful mine. "Last winter," he writes, "the subject of depletion being on my mind, it occurred to me to look up what had become of the various mines I had worked on. The result was illuminating, and I think it bears by inference on the general theory of depletion." It does more, we would add: It demonstrates conclusively that proof is available to indicate that mining is more of an industrial pursuit than an adventure for gamblers and financial desperadoes. Convincing evidence is forthcoming of the great opportunity that exists, by investment in the mining industry, to obtain security, appreciation of capital, and high interest rate. The single mine is almost gone. Alone it failed to pay. United by merger or consolidation, a group holding may be a most profitable enterprise. To make a "lucky" investment, concludes Mr. Finlay, is to discern the men and the organizing processes destined to make the most of a great mineral district.

I HAVE now been engaged in mining for forty years; and heard it talked about for ten years before that. My first idea was very nearly like Mark Twain's: "A mine is a hole in the ground owned by a liar." When I went into it I did not regard it as an industrial pursuit, but as an adventure for gamblers and financial desperadoes. I was not a gambler myself, but was willing to work for gamblers if they were foolish enough to pay me. It was too risky; I would save my money and put it into real estate. I did that, only to be nonplussed in the course of time to observe that nothing came out of the real estate except bills for taxes and improvements. In my maturer years, by the way, I gave that real estate away to an aunt of mine, with the warning that I considered it a liability, not an asset.

What led me into mining was not interest in the business, but a desire to see out-of-the-way places. I was interested in geography and geology; I wanted to explore; and mining seemed to offer a chance to do that and get paid for it. Ten years of it did take me to out-of-the-way places—in Colorado, Oregon, Nova Scotia, Michigan, Wisconsin, Minnesota, Ecuador, Peru, and to different places in those countries, and on various trips to the same places at different times. I had seen booms and excitements; Aspen and Cripple Creek in their flush and prime, and the opening of the Mesabi range. I had been geologist, surveyor, land-looker, prospector, shoveler, miner, shift boss, foreman, and superintendent of two mines. I had carried packs on my back through the swamps of Lake Superior, camped among the mosquitoes and in the snow, followed burros across the Rocky Mountains, shot at condors from the summit of the Andes. I was not an adventurer, did not court risks; like Dr. Douglas, I minded my own business and kept out of dives, in the interest of safety. Still I suppose I had some adventures, and from the point of view of the suburbanite, the life was not humdrum nor conventional.

To run biography back to mining: there was one risk I never took; I never put a dollar on a share of mining stock. I thought that success in the business came purely from the luck of finding a valuable deposit of ore. If the ore was good enough, anybody could make money out of it; for a time, anyway. There was such a thing as good management. It would make some difference; not a great deal. "A good mine makes a good manager," was a stock phrase that I agreed with; rather unwillingly to be sure. It didn't seem quite fair; but such was the mining business. I did not expect to be lucky enough to find a good mine for myself, I hoped merely for the luck of getting to be manager of a good one, and thus become great, and get a big enough salary to enable me to save up a competence that I could salt down in something safe. Still, at the end of those years I was beginning to have shrewd suspicions about real estate.

Mining was not a competitive business.

In the last ten years I have settled upon a startlingly different idea: Mining *is* a competitive business; as competitive as baseball. Mines do not make men; men make the mines. Success in the business arises from old-fashioned virtues, talent and skill; from being a good mining man oneself, and associating with others that are good. It is not exactly a game, but it is exactly parallel to a game. If one is to be a champion one must play with champions; to play with dubs is to remain a dub.

To be sure, mines must exist; ore must be found and developed; ownership must be secured; but the attribute of proficiency is to cover all this ground. It is not proficient to stand idly by with such excuses as "I can't find a mine," or "I have no capital." Discoveries and money must be made; it is childish to expect them to be handed you on a platter. Men who have demonstrated that they are championship miners do not have to worry about opportunity or capital any more than Babe Ruth has to forego baseball for want of a bat, or Walter Hagen golf, for lack of some clubs. Precisely as Ruth or Hagen never became champions by playing baseball once, or golf once, but rather by assiduously training, practicing, and adding skill to natural talents, over a long period of years—by getting competitive experience—so a miner does not become established by one chance experience or by a single stroke of luck. And just as a Ruth or a Hagen cannot be a great player unless there are other great players to contend with—if only one

AN INVESTMENT OPPORTUNITY

Consolidation, Group Operation, and Engineering Leadership

By J. R. FINLAY

—These have insured a financial success the extent of which is inadequately realized

man played baseball or golf, he could have no fame except perhaps as a curiosity!—so no man can succeed in mining by himself; he can only be preeminent by meeting all challengers. But he must not be all challenge, all opposition, either; he must invite cooperation by the best men in sight, just as Babe Ruth must be on a good team of other capital players if he is to get a cut in the World Series. After all, he can only help win a pennant.

Just so, mining is a vast co-operative industry; the best man in the world can do no more than help others carry it along. Still further, no success can be had if one acts as if there was no other industry; it has in the aggregate, millions of contacts with other lines of effort: it is, in short, just one of the fields of civilized activity. It is, moreover, indispensable to civilization and, so far as we can imagine, it must be as permanent as civilization.

What, then, has this conclusion to do with the depletion of mines—another word for the impermanence of mines? We all know that orebodies can be, and have been, and will be, exhausted; therefore individual impermanence is a fact; a condition, not a theory. We have, then, a contradiction, a paradox: the expectation of permanent supply based upon temporary and successively vanishing sources. My conclusion is that this paradox is, or may be, no more difficult than the permanence of a race of animals made up of short-lived individuals. That conclusion is open to argument, but for the time being let us suppose it to be valid.

We have therefore the same distinction between a mine and the mining business as we have between an individual and a race, between a person and society; the one evanescent, the other permanent. This distinction is to a certain extent obvious, and it is obviously important, but there are in it implications that will take considerable observation and reasoning to unravel. Let us begin by tracing out some considerations that have been borne in upon me by experience:

For one thing, I believe we are just passing out of a period in which the fear of depletion, the expectation of impermanence, became, one might say, fashionable. Skepticism was in vogue. It seems to have come about this way: In the early days of mining exploration by English-speaking peoples in various parts of the world, and more particularly I suppose in America, the chief object of search was the precious metals, in the far-off wilderness, hedged about with Indians, six-shooters, and romance. Where the imagination demanded romance there came a quick supply of romancers; there were "professors" pointing out the location of the pot of gold; clothing their discourse in high-sounding phrases; Silurian, Eocene, Plutonic; promising vast but unspecified wealth.

Those who took mining seriously, even gold mining, perceived that there was no money in vagueness. They began to make short shrift of phrases, illusions and fables; and substituted the multiplication table and the tape measure. Hope was abolished or minimized; the only thing about a mine worth attention was the ore "in sight." There came in then a vogue of exactness which dominated the literature of mining for many years. It was taught in the schools, and it has persisted nearly, if not quite, to this day. At any rate, it was the philosophy which kept me from buying mining stock for ten years.

The technical journals were full of learned discussions of the purest arithmetic, such as how to sample ore, how to sample a mine, how to measure ore reserves. I have seen "estimates" of profits that began with millions of dollars and ended with fractions of a cent. Cost statements were made showing details down to thousandths of a cent. I finally began to realize that there was something ridiculous about this exactness. It was largely a mere fashion, and was no more sacred than the bustle or the leg-of-mutton sleeve. For one thing, decimal fractions could be used to advertise a humbug, just as well as to describe a bonanza. Calculations, however meticulous, are no more correct than the premises they start with, and in metal mining these premises are nothing but observations.

In judging of the merits and speculating on the future of a mine, therefore, the main thing is the justness and completeness of your information. A square mile of land underlain by a uniform bed of coal of known thickness and quality is one thing, a very common thing; but ten thousand tons of lead or copper ore in an irregular mass, squirming through hard rock, is a very different thing, also very common. That ten thousand tons may be all there is there, or it may be only a sample of ten million tons. Leaving out for the moment the question of whether or not there are other means of judging, it is evident that so long as there is uncertainty to start with, precise calculations on that uncertainty cannot clear it up.

I say I came gradually to entertain doubts as to the merits of this vogue of exactness. For one thing, it was current only with the technical staffs, the so-called professional mining engineers, seldom among the men who actually bought mines and controlled them. According to technical opinion, such men were taking reckless and

absurd chances — in plain English, making fools of themselves. The general public of investors were the biggest fools of all; the prices they put upon mining properties were two or three times what the actualities would warrant. I found it very disconcerting to notice that these fools did not always lose their money, but, through some injustice, continued to make it, while we wise men continued to be poor. I began to wonder whether we were wise men or only wiseacres, and finally came to the conclusion that that was a question at least worth pondering over. To cut the matter short, I became impatient with the mental processes that fashion or education prescribed for the conventional "mining engineer."

There was taught a sort of futile worship of actualities; to consider what one could see and nothing else; and not to consider that most potent of practical actualities: change, evolution. The only use for history was to dismiss it with the vacuous phrase: "Oh! that's ancient history!" Actually some engineers had no curiosity about the sun except to draw a north and south line from it. That was practical.

Now, to be practical in dead earnest, what did this frame of mind, this banishing of historical perspective and of imagination from the orthodox realm of actuality, mean in dollars and cents? Just this: a mine must be valued chiefly on the depletion of its "reserves." Its value is at the maximum right now and must hereafter decline. In a few years it will come to nothing. The assumption that it will continue to earn over a considerable period of years, or that it will earn progressively more, is foolish. But since mining stocks are valued just that way, the price is altogether too high; therefore no well-informed man will buy them.

So long as I was actuated by this reasoning I bought no mining stocks, earned nothing out of the business except a salary, and lost my savings by putting them into poor investments in another field, of which I knew nothing. That process continued so long that I almost gave up hope of ever acquiring a competence, entertained very modest expectations of my earning power, and considered myself only a sort of proletaire.

The merits, or demerits, of this style of reasoning could no doubt be analyzed philosophically on *a priori* grounds, but I have thought of another which I hope will be more interesting; simply to trace out what has become of the mines I have worked on or been interested in.

Out of twenty-seven properties, seven of them have been absolutely worked out. In these, six are gold or silver mines in Colorado, Nova Scotia, New Mexico, and Nevada, and only ne, the Goldfield Consolidated, ever took on any importance. The other property was only a lease at Joplin, Mo.

Of the other twenty mines, some indeed have been worked out, but they have left successors; to how much effect one may judge by the following list:

The Minnesota, at Souden, Minn., a hard-ore mine on which I worked in 1894, would not, I thought, last many years, but it is still going, on a reduced scale. The Norman mine of the same company (1895) was a forty-acre lease which was, I think, finally exhausted about 1918. The American Steel & Wire Company (1899) was in 1901 absorbed by U. S. Steel. The Minnesota Iron Company was absorbed by the Federal Steel Company, and the latter by U. S. Steel. If, then, I had bought stock of the Minnesota Iron Company, or American Steel & Wire, I would have been paid a good price in Steel Preferred at 100, plus a bonus of Steel Common at 50, and if I had held both till the present day I should have found the preferred selling at $142 after paying $7 a share all these years, and the common at about $240. In round numbers, the stock would now be worth, I believe, at least five times what I should have had to pay for it, besides paying a handsome yearly return for between thirty and thirty-five years.

Between 1896 and 1899 I worked for the South American Development Company, which was opening up a gold mine at Zaruma, Ecuador, which is still operating successfully. There was, however, no opportunity to acquire stock in this concern, at least not to any great advantage.

In 1889, I worked a few months for the Cleveland-Cliffs Company, of Marquette, Mich. This is still an important property with a vastly long life ahead of it; but whether there was ever any opportunity to acquire stock I do not know.

> *"Mines do not make men; men make the mines . . . by talent and skill . . . by associating with others that are capable. . . . Men who have demonstrated that they are championship miners do not have to worry about opportunity or capital . . . Discovery and money must be made; it is childish to expect them to be handed to you on a platter . . . Mining is a vast co-operative industry; the best men in the world can do no more than help others carry it along . . . It is, moreover, indispensable to civilization and as permanent as civilization . . ."*

In 1900 and 1901, I worked on the Standard mine in the Coeur d'Alenes. I could see only a short and doubtful life ahead, although it was then about the best mine in the district. It was bought in 1903 by the Federal Mining & Smelting Company, together with the Mammoth, another property on the same vein. Both were worked out and shut down about 1916. I thought the Federal Mining & Smelting Company was an extravagantly overcapitalized and overvalued concern ($18,000,000) and would not have touched it with the proverbial ten-foot pole; but all preferred dividends have been paid, the preferred stock stands at par, and the common at about $250 a share, after 25 years. In the last five years its earnings have been some $13,500,000, equal to 75 per cent on the original capitalization.

In 1901, I also had charge of the Hecla mine. It seemed small. I had little faith in it and gave such scant attention to the stock that I don't remember exactly what it sold for—I think at about 70c. or 80c. a share. After 28 years the stock is worth about $18 a share and has paid that amount in dividends. I did, however, buy stock in this concern, in 1915, at $3, and have since repaired the mistaken idea I entertained in the first place.

In 1902, I worked for the Bunker Hill & Sullivan for a short time. It was not making much, if any, money, was harassed by litigation, seemed low-grade—very likely an empty shell. I remember believing that it would be long-lived, because the mineralization was so extensive, but I thought the profits would probably be meager or spasmodic. I never even inquired about the price of the stock, but understood it was closely held by a group of rich men who didn't care much, or didn't know any better, one of them being John Hays Hammond, and another F. W. Bradley. At that time it had paid in sixteen years a scant million dollars in dividends; since then some forty millions in 27 years. At present it is paying at twice that average rate.

In the latter part of 1902, I went to the Portland Gold Mining Company, of Cripple Creek, Colo. For the first time in my life I made bold to buy some of the stock, on the strength of doubling the profits. I was, however, dubious and cautious, and with reason; but I got out with some profit. At this stage I began to modify the theory of valuing a mine on the ore in sight, and believed it to be good for ten years, although the engineer estimated only enough for one year. This mine is still working after 27 years, but of late unprofitably.

In 1903 and 1904, I was in charge for six months at the Federal Lead Company in southeast Missouri. It was not making any money, but here I continued breaking away from the shackled imagination of the ore-in-sight formula, believed in the future of the district and urged the expansion of the company. These visions were a little slow in materializing, and it was not until 1909 that the property began to make real money, under Mr. H. A. Guess. Twenty years after my first acquaintance with this property I recommended its purchase by the St. Joseph Lead Company for $10,000,000. At that figure it has proved a startling bargain for the latter concern, although for a variety of reasons too intricate to explain for the time being, it was, I am sure, a good sale on the part of the former owners; in short, rather a fine example of the benefits that sometimes

accrue to consolidations in the way of economies that spring from the removal of boundary lines and avoiding duplicated plants. Before this purchase, St. Joe stock was valued in the market at some $25,000,000. I sold mine this year, when the company's stock valuation aggregated $175,000,000, believing that some buyers of it were feeling over-gay.

To lengthen the list: In 1905 I made an examination of the Silver King mine, at Park City, Utah, and recommended its purchase for $3,300,000. There was not much ore in sight and it looked like an empty shell; but I liked the property. I was now breaking away decidedly, from "ore-in-sight," but measured mines rather on the strength of the mineralization. This is a complex idea, not one to be explained in a few words; rather a matter of instinct than of mathematics; something acquired by experience. At any rate, this mine with a story of some ups and downs has been successful, and is now valued at some $17,500,000. After 23 years from my last visit, and 37 years after its discovery, it has, I am told, a long life ahead and is making more money than in its days of supposedly short-lived bonanza.

Between 1906 and 1912, I had some contacts with a number of properties from which the lesson was on the other side, breeders of caution. The Creede United mines, of Colorado, the Mogollon mines, of New Mexico, were not there with the goods, and have disappeared. Goldfield Consolidated was a brilliant meteor, but it soon grew cold. I saw plenty of good mines, like the iron and copper properties of Michigan, but few of these that I cared to invest in. I did get some stock, at times, in Goldfield Consolidated, Miami, Utah, U. S. Steel, Braden, and Nevada, but touched them very gingerly and the first show of profit generally scared me out. I had a good deal to do with Chief Consolidated, under Mr. Walter Fitch. This was, and is, one of the boldest and most logical schemes I ever ran across; too bold and too logical for me. There was not a grain of ore in sight; I wanted *some*. Mr. Fitch started with nothing but the control of a wildcat that owned about half an acre of ground, and an option on a claim called the Granite. His idea was simply to acquire property, in a district known to be mineralized: ore could surely be found on it.

Beginning with half an acre, he has acquired five thousand, perhaps eight or ten thousand, acres. He has had some ups and downs, some good luck, some bad, but he has proved the correctness of his theory by finding ore at four or five different places; and he has paid big dividends on the capital he started with. One would have to be bold indeed to set a date for the final exhaustion of Mr. Fitch's property. It is in the heart of a district that has already lasted 57 years, and I doubt if it ever had three months' honest-to-goodness ore in sight in its life; that is, such as a conscientious expert could measure with his tape.

Late in 1912, I was engaged by Mr. Clinton H. Crane, then a member of a stockholders' committee proposing to reorganize the finances of the St. Joseph and the Doe Run lead companies, to appraise both properties, and recommend a basis for consolidation. It was here for the first time that I discarded the conventional methods of forecasting the future of such a property, and placed the probable output at 1,400,000 tons of lead, about 35,000,000 tons of ore, against engineers' estimates of about 4,000,000 tons in sight. When the local managers were apprised that they were expected to realize such figures, their nerves failed them and their hands dripped with cold sweat. Such was the inertia of a habit of thought. I used the very thing which I believe technical men had been taught to ignore: history. It is probable that my estimates have been exceeded already, but meanwhile certain factors have come into play that were not then to be counted on.

"We are passing out of a period characterized by fear of depletion and expectation of impermanence —an age of illogical exactness— . . . Now, to judge the merits of a property, the important factor is the justness and completeness of your information . . . Many mines in the past have appeared as losing hold, with no future; yet today those same mines constitute the backbone of the industry. Consolidation and engineering leadership have given them long life, and to their stockholders an excellent return on the investment."

I did not lose sight, altogether, of the prospect of improvements in the industry, but I did not foresee that in fifteen years the yield of metal from the ore would be increased by 30 per cent and the output per man by 125 per cent. Multiply those factors together and you find that a man can produce nearly three times as much lead as he could in 1913. Though wages have been more than doubled, there is still room for profit on ore carrying only two-thirds the metal of the standard ore of those days—making a large addition to the available resources. I believed, moreover, that if one could foresee a life of twenty years for the property, that was enough to give it nearly the same present value that it would have with a longer life.

I figured the present value to be about $20,000,000 and, finding that the stock could be had on a value of $9,000,000, I proceeded to buy some, and continued doing so for ten years. This property also was the first capital example that I was fortunate enough to fall in with of what one might call operating mines on an industrial basis rather than on a wasting basis.

Mr. Crane became president of the consolidated company and has remained so ever since. He found the property with a $7,500,000 debt, and his gravest preoccupation at first was to ward off the danger of its being taken over by creditors. He has asked the stockholders for nothing, paid liberal dividends, increased the value of the stock fifteen times over, and so far from exhausting the resources of the concern has increased them on all sides. The property has as long a prospect of life in the same field as it had in 1913, with more than twice the annual output. The St. Joseph Lead Company, by the way, is 64 years old. To what extent its history is a comment on the philosophy of mining, such as I found during my first years in the business, I shall deal with later.

The record of my dealings with mining properties and stocks does not end here, but I will cut it short. There were Granby Cons., Calumet & Hecla, Miami, Phelps Dodge, Nevada Consolidated, and Kennecott. My only contact with Miami has been as an interested visitor; with Nevada Consolidated only through an appraisal of the Chino mine for the State of New Mexico; with Kennecott only as a spectator. I have had stock in all of them. But, to sum up, the present representatives of the 27 properties I have worked on are the following:

United States Steel Corporation
South American Development Company
Cleveland-Cliffs
Federal Mining & Smelting
Hecla Mining
Bunker Hill & Sullivan
Portland Gold Mining (nearly defunct)
St. Joseph Lead
Silver King Coalition
Granby Cons. M. S. & P. of Canada
Calumet & Hecla
Phelps Dodge Corporation
Nevada Consolidated Copper
Miami Copper
Kennecott Copper Corporation
United Verde Extension
Anaconda Copper
American Metal Company
Calumet & Arizona
American Smelting & Refining.

I have forgotten to explain by what processes I came in contact with some of these. I might perhaps add International Nickel, but I was never on the ground. The main point is that, having made up a list of 27 mines that I have worked for in some way, these properties are now represented by direct descent by twenty concerns, including several of the largest industrial units of the world. Out of the whole list only three or four can reasonably be held to be in any danger of extinction within, say, twenty years through depletion.

And what kind of an answer is this to the arithmetic and tape measure of ore reserves, to the theory of appraisal that we have been brought up with, and the logic of actuality? Lest any

one jump to the conclusion that I am arguing for unbridled optimism, I hasten to say that one may see long lists of stocks in the daily papers, traded in on various exchanges from Atlantic to Pacific, among which one has to be an optimist to find two or three that are worth the paper they are written on. All I say is that having had some experience with poor properties, I set about to look for good ones, to such effect that I have had to do with the list given in the foregoing; and it is hardly worth while remarking that these properties are worth vastly more today than they were ten, twenty, or thirty years ago.

It now appears that all I needed to do to make a fortune was to put my savings into the stock of every mine I worked for and hold on. And this at the going prices, whatever they were. I might have lost a little on two or three, broken even on three or four, but on twenty I would have made profits, sometimes as much as ten, twenty, or thirty to one. I can hardly insist too strongly, or repeat too often, that the vast majority of these mines seemed to be losing value instead of gaining it; many, many times the story was one of departed glory; some splendid orebody worked out, the like of which would never be seen again; nobody but the crassest ignoramus would be fool enough to expect another like it.

Speaking broadly, the explanation of all this seems to be that during these years of my experience a revolution has occurred in the mining business, so that the aspect of it has been pretty thoroughly changed; and the changes have been coming on so gradually that we have hardly adjusted our ideas in like step. One will focus his attention on one or two properties, like Utah Copper for example, and marvel at the change in it and the success of it, without realizing the rapidity with which that success has caused its procedure to be followed by others throughout the world. I shall try to analyze the nature of this revolution with the idea of putting the emphasis on the salient features, continuing to use as a text the preceding list.

To begin with, these properties are seldom mines at all, in the sense in which that term was understood forty years ago and in which perhaps it should be understood even today; they are rather entities for which many titles have been invented; holding companies, mergers, consolidations, chain stores, trusts, and the like. They are generally the successors in interest of a number, sometimes a multitude, of smaller entities that were once mines of the accepted type. Out of these a large proportion are now, even under the present ownership, quite depleted; and a still larger number would be utterly profitless to anybody if left to their original selves. This is true even of seemingly compact operations which one might naturally and properly call individual mines.

For example, what is now known as the Rivermines Division of the St. Joseph Lead Company, producing today something like 100,000 tons of lead a year, at a profit of, say, $5,000,000 a year, is composed of at least eight former mines, every one of which, if left to itself, would have been closed up long ago. I can think of six of them that were actually equipped and operated as going concerns, but gave up the fight, closed down, and sold their acreage for what they could get. And were these properties poor ones? That is just a matter of how you take them. Under the conditions in which they were worked they were utterly without value; under the conditions created by St. Joe, they form collectively a bonanza. That is not saying enough: under the *boundaries* with which they were created they would still have little value, even given all the resources of up-to-date practice and finance; and still further to emphasize the point, those boundaries were not so very restricted, in some cases up to a thousand acres of ground known to contain lead. That was not enough to meet the requirements. Indeed, to tell the whole story, even the Federal Lead Company, a great holding of fifteen thousand acres, in the hands of a great concern like American Smelting & Refining, operated by so able a manager as Mr. Guess, was faced with formidable difficulties. It was not exactly unprofitable, but its sources of ore were scattered in various tracts. To concentrate them into one effective and economical operation would require the building of a new power plant, constructing long haulageways underground to reach rather small bodies of ore; in short an investment of several millions that would in large part merely duplicate facilities that St. Joe had already at hand. These were difficulties imposed by widespread and interlocking ownerships. It was better business to save the useless expenditure of these millions and put them into some other enterprise where they would serve a more fertile purpose.

One might say that economic wisdom urged to combine the properties either by sale or by an interchange of stock. It was done by sale, and it was a transaction highly profitable on both sides. The Smelting Company did not leave the field; it merely gave up its mines and concentrated upon the smelter, which was admittedly a better plan than that of St. Joe; and, to make it better still, the latter company agreed to ship to it some two-thirds of its own products, thus insuring that the plant should always run at full capacity, with minimum overhead and maximum economy. By such means savings that come up to staggering figures have been brought about practically for nothing—except the use of the common sense required to agree to a plan!

Is not this a pretty good illustration of the truth of the conclusion I mentioned as having come to—that it is the men who make the mines, not the mines that make the men? After all, there is nothing like headwork. The great problem of making a "lucky" investment in Southeast Missouri (to stick to the present illustration) has been, then, not to see that it is a great mineral district —anybody with half an eye could see that—but to discern the men and the organizing processes destined to make the most of it.

Reducing Belting Expense

WRITING in *Power Transmission*, E. W. Zimmerman describes how old leather belts may be taken apart and backed with cotton, to obtain a maximum service, greatly reducing cost. The rules given are:

1. Purchase good quality double leather belt, medium or heavy grade.

2. Use this belt as double leather just as long as it will stay together and pull. This usage may also include taking down and regreasing several times.

3. When the leather belt refuses to function any longer, pull the plies apart, thoroughly clean with gasoline and allow to dry. The bad spots are then cut out of the original belt and the good ends spliced as single ply.

4. Woven cotton belting of desired width and thickness is purchased, and a roll of approximately 500 ft. stretched over rollers. This stretching is done a little at a time by a winch at each end. When all possible stretch is out of the canvas, it is sized with glue and allowed to dry.

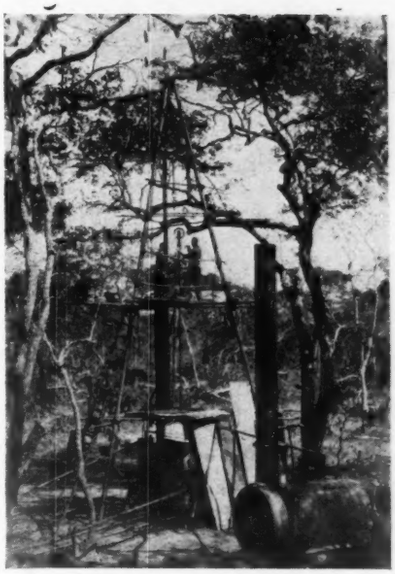
5. A glue is made especially to cement the cotton to leather and to be pliable, so as to travel over pulleys at a high speed without cracking.

6. The one ply of leather is then cemented to the canvas, the glue always being kept at the correct temperature by means of electrically regulated heat.

7. The finished belt is cut to proper width by bringing the leather down to the width of the canvas, the canvas edges not being cut.

When all the elements of this belt are properly made and carefully assembled, satisfactory results are produced. When ready to use, the leather is treated with a neatsfoot oil preparation and is mounted with the leather side to the pulley. The chief function of the leather is traction. The cotton gives the strength, and also affords a resistance to stretching, which is not obtainable in leather belt unless the leather has previously been stretched beyond its elastic limit, which is poor policy. Every new leather belt needs several take-ups during the first month of its use in heavy service; but this is not necessary with the composite belt.

THE COPPER DEPOSITS OF NORTHERN RHODESIA—II



Diamond drill in operation at the N'Kana properties

By ANTON GRAY *and* R. J. PARKER
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MOST of the N'Kana Concession is underlain by a great mass of granite, deeply eroded, but containing remnants, or roof pendants, of the older schists and sediments of the system of Katanga. Only along the Rhodesian-Congo border do the sediments exist in a large continuous structure, too large to be considered as a remnant. Here is a great depression in the roof of the granite batholith, which rises again farther to the east.

The major structure of this area must originally have been that of a great irregular dome, on which many smaller folds were superimposed. Synclinal portions of these have escaped erosion, and form the sedimentary remnants now exposed. The core of this structure was composed of the older schists and younger granite, in which the sedimentary remnants are now found. The border of sediments, as shown in the geological maps of the Rhodesian Congo Border Company, except along the Rhodesia-Congo frontier, now lies well outside the concession, the capping of the sediments and much of the granite having been removed by long erosion. Evidently, the uplift which caused this structure was accompanied or caused by the intrusion of the granite mass.

The sediments along the frontier have been folded into the form of a great trough or syncline, lying in the schists and granite. This syncline has a general northwesterly trend, and at Mufulira it is about ten miles in width. To the south it widens, and only the westerly limb enters the concession intermittently as far south as N'Dola. To the north, the westerly limb of the syncline swings round still further to the West, eventually re-entering Rhodesia in the Rhodesian Congo Border Concession, northwest of Tshinsenda. In the details of its structure this syncilne is not simple. It is here that the Roan, Christmas, Mutundu, and Purple Quartzite Series are best exposed, but these rocks are intricately folded and faulted. Along a line more or less parallel to the trend of the syncline, and from Kasaria to Kipula, is evidence of considerable faulting. The dip of this fault, or faults, is not known, but it appears that the eastern block has been moved up with respect to the western, probably over 15,000 ft.

As far south as the Mutundu stream, the western limb is more or less regular, but here it is intensely crumpled, and broken by cross-faulting. Just North of N'Dola the strike is broken by a small dome of the underlying granite, the main mass of sediments passing to the east, and only a shallow trough lying between this and the main granite mass to the west.

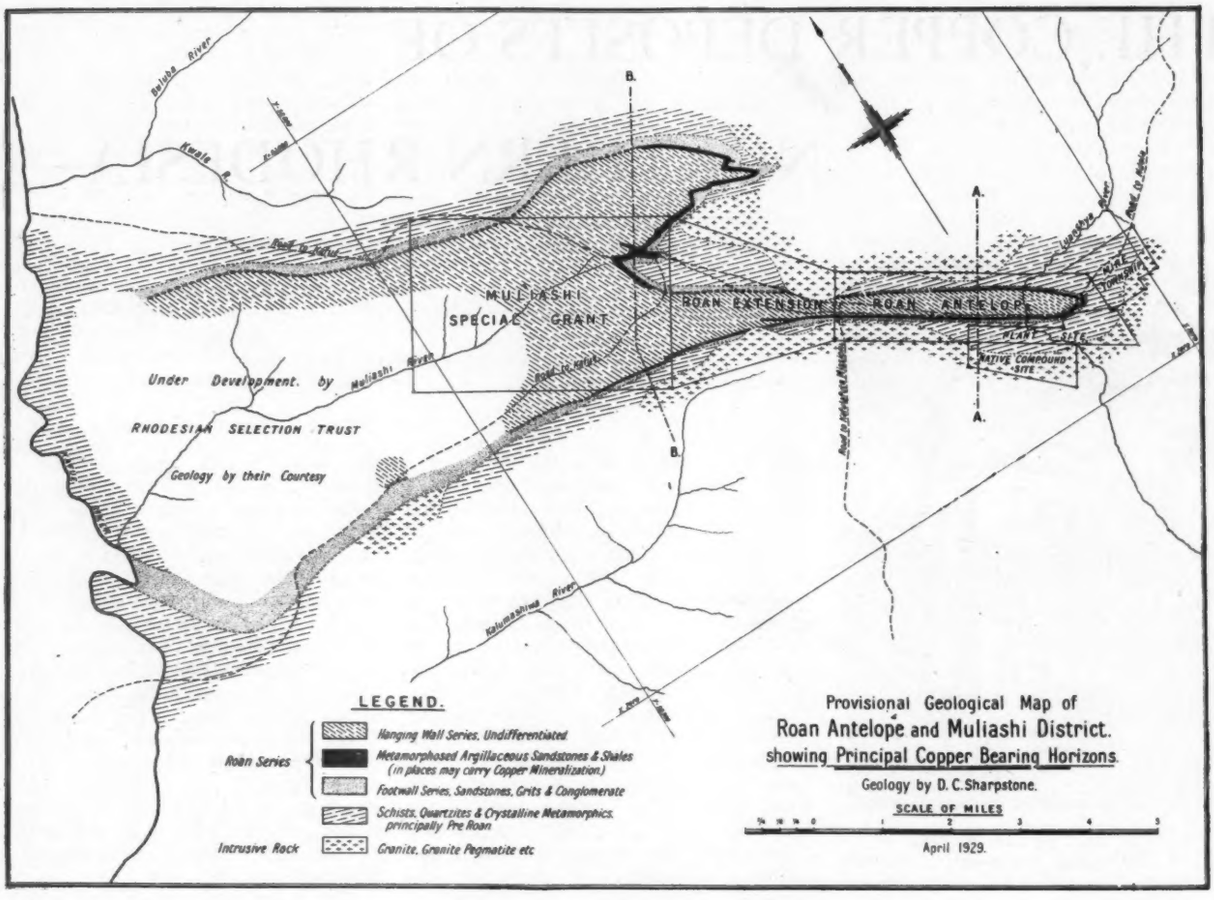
Near the Southern Concession boundary, at the Roan Antelope mine, is a comparatively small area of the Roan Series almost wholly surrounded by the granite. This tightly folded synclinal remnant, about 16 miles long, one-half mile to three miles wide, and probably not over 3,000 ft. deep, contains the Roan Antelope and Muliashi orebodies. The only other areas of the Roan Series known in the concession are those of Chambishi-N'Kana and Kalulushi. The Chambishi area is underlain by a fairly flat basin of sediments, which, however, is deep enough in the center to contain a small remnant of the overlying Christmas and Mutondo Series. An extension of this structure, in the form of a more tightly folded syncline, extends to the southeast as far as N'Kana, and contains the N'Kana orebody.

The Kalulushi area is just south of the Chambishi-N'Kana area and not entirely separated from it by a narrow neck of schist and granite. At Kalulushi prospect the structure is similar to N'Kana, but in this formation the wide structure west of the narrow nose of the syncline passes into Rhodesian Congo Border Concession ground.

So far as we are able to tell, the structure of the gabbro found in the Muliashi, Kalulushi, and Chambishi areas conforms more or less to that of the sediments. It appears to exist in the form of large sills, possibly lopolithic in part, contained in the sediments of the lower Roan Series. This gabbro, or diabase, has not been found in the Mufulira-Bwana M'Kubwa area. At Kalulushi a drill has penetrated one of

Native huts under construction at the new compound in N'Kana

This is the second of a series of articles on this subject, the first of which appeared in the issue of Sept. 7. The issue of Aug. 31 contained bore-hole maps and drilling results at Roan Antelope, Mufulira and Chambishi.



these diabase sills and passed through into the underlying sandstone.

GEOLOGIC events in this area before the deposition of the sediments of the system of the Katanga are exceedingly obscure. Certainly the Muva and Lufubu schists are very old rocks, and must have passed through a long and varied history to reach their present condition of metamorphism. During at least one period they were intruded by a great deal of granite; this was probably a period of mountain building. During this period of igneous activity they probably reached their final state of recrystallization. This was evidently followed by a period of erosion, which must have proceeded far enough not only to furnish the material of which the overlying sediments are formed but to expose much of the granite to a great depth.

Upon this surface of the older schists and granites was laid down the basal formation of the Roan Series. That these rocks are largely continental in origin and laid down in very shallow waters there can be little doubt. The variability in thickness of the basal conglomerate and the coarse cross-bedding of the overlying sandstones, as well as their feldspathic nature, indicate rapid accumulation, probably on a very uneven surface. The area over which these sediments are found indicates that in time the body of water in which they were laid was extensive and probably fairly deep—a large lake or possibly an epeiric sea. After the deposition of the sediments of the Roan Series, during which there must have been a large volume of water, shallow-water conditions were probably again brought about, and, locally at least, sufficient erosion of the upper Roan sediments occurred to cause local disconformity between these and the overlying Christmas Series.

BETWEEN the formation of the Christmas Series and the deposition of the fluvio-glacial conglomerates at the base of the Kundelungu, considerable change in conditions must have resulted. Nowhere in the concession is any evidence of erosion of the Christmas shales or sandstones. Neither is evidence available in the concession as to the source of the materials which form the conglomerate at the base of the Kundelungu. Only the presence of these rocks themselves furnishes certain evidence of a break or change in conditions of deposition. Succeeding sediments of the Kundelungu Series, laid down without break on the basal conglomerate, indicate deeper and deeper waters, marked by the deposition of dolomites and dolomitic shales. Then, without sudden change, the waters became shallower and the sediments more and more sandy, until the coarse and partly feldspathic Purple Quartzites were laid down.

The age of the system of the Katanga is unknown to us. We are not familiar with the formations of South Africa with which a correlation has been suggested, and no fossils have been found in the beds. From the nature of the beds, however, we do not believe that this necessarily indicates a Pre-Cambrian Age. Fossils might yet be found in the upper, poorly exposed parts of the system.

Belgian geologists have suggested a correlation between the Tillite of the Katanga and the Dwyka tillite. Descriptions of the Dwyka and lower Ecca, given by Du Toit, appear to indicate a similiarity between these formations. A specimen of the lower Ecca we have obtained closely resembles parts of our lower Mutondo, or Kundelungu Series. But the question of the age of these beds, so far as we know, is still unsolved.

AT SOME TIME after the deposition of the sediments of the system of the Katanga, including an unknown thickness of beds above the Purple Quartzites, there was still another period of great earth movement. The sediments were complexly folded and faulted, and presumably the land surface was greatly elevated. This was accompanied by, or in part caused by, the intrusion of great masses of granite—which we now call the younger gray granite. If this granite is responsible for the copper deposition, the formation of the ore deposits followed closely this period of

igneous activity. It is probable also, but we have as yet no definite evidence, that the gabbro and diabase found in the western part of the concession were intruded into the folded sediments after the formation of the granite batholith. We have no evidence as to the absolute geologic time of this igneous activity. We only know that sufficient time has since elapsed for the rugged topography then formed to be eroded to a comparatively flat and featureless plain, probably a peneplain. It is this plain, with the drainage established on it, that is the dominant feature of the present topography.

Comparatively recently a rejuvenation of the streams on this old surface has occurred, probably caused by a re-elevation of the land. The streams have commenced to entrench their channels, and the valleys are being deepened. A new topographic cycle has started, and is at present in its infancy.

Ore Deposits

All the known copper deposits in and near the N'Kana Concession are found in the Roan Series, very near the base of the system of the Katanga. Several of these have been sufficiently well developed, principally by drilling, to be considered as mines, though only Bwana M'Kubwa is as yet in the producing stage. The Roan Antelope is, so far as is now known, the largest and most highly developed, but large and valuable orebodies have been proved at N'Changa and N'Kana. Of the Rhodesian Selection Trust properties, valuable orebodies exist at Mufulira and Chambishi. Mufulira at present appears to be much the larger of the two, but further exploration may reveal extensions of considerable size at both places.

A great similarity exists between the copper deposits of this area. Fundamentally they are of the same type, and differ mainly in only two important respects. The first of these is the nature of the orebearing rock, which may be shale, dolomite, or sandstone. The second is form, which depends entirely on the structure of the containing beds.

All are bedded deposits, the copper minerals occurring as a more or less regular dissemination along one or more definite horizons. The orebodies therefore are tabular in shape and fairly even in width. Outcrops of these orebodies are small, and often no outcrops are present; when and if found they rarely give any indication of the size or importance of the deposit. The mantle of soil is deep over the entire area. Pits have been sunk to a depth of 80 ft. without exposing say recognizable rock, but, except over the more resistent quartzites, 30 or 40 ft. is probably the average depth of overburden.

The few outcrops which have resisted this decomposition are usually well leached. In the harder quartzites, finely disseminated chalcopyrite and bornite have been found at the surface; and, in somewhat more altered rock, chalcocite has been observed in several outcrops. Usually, however, malachite is the principal copper mineral, sometimes accompanied by subordinate azurite, cuprite, chrysocolla, and native copper. The malachite is often scattered through the rock in small evenly disseminated particles, as is much of the sulphide below, suggesting oxidation in place. A smaller amount usually is found well crystallized in small veins and joints in the rock. Chrysocolla and native copper always occur in this manner. Cuprite may be found in small veinlets or coating minute grains of chalcocite, and is usually associated with a little native copper.

Although some hematite and limonite are to be found in nearly all the outcrops over proved orebodies, they occur in surprisingly small amounts, considering the amount of iron present in the soil. This is probably owing to the thorough leaching which the orebearing rock has undergone by acid sulphate waters, and by the fact that the outcrops represent for the most part a portion of an oxidized chalcocite zone. The iron is often accompanied by manganese and copper oxides.

Limonite casts, resembling pyrite in shape, are to be found in the leached rock at many places along the copper-bearing horizons. These are seldom associated with any amount of malachite, but much of the limonite gives a distinct copper reaction in the flame. No cobalt has been detected in any outcrops, though this metal occurs in small quantities at greater depth.

Much has been said, in connection with this district, of copper dambos, or open spaces along the outcrops, as an indication of copper. Copper weeds and various different kinds of vegetation have been described as indications of the underlying rock. It is quite true that in passing from one rock to another a very distinct change in vegetation may often be noted. Open spaces exist over, and outline, with remarkable exactitude, the outcrops of some of the orebodies. The Roan Antelope is the best example of this. There a dambo followed almost entirely around the trace of the ore bed, and first suggested its true synclinal structure. But this is true also of rocks which carry no copper. Such dambos occur at many places over the Muva quartzites where these rocks exist close beneath the surface. On the other hand, at Mufulira, over the richest deposit yet found in the concession, not the slightest sign of any open space is to be seen, even where the more or less leached orebody outcrops.

Lack of vegetation, or the preponderance of certain types of vegetation, must be the result of various causes, such as depth and kind of soil or drainage. Any considerable amount of the salts resulting from the decomposition of copper minerals might have a noticeable effect on the vegetation, and under certain conditions this appears to be the case. But of the various factors involved, it is hard to determine which has been of greatest importance, and one cannot say that an open space, evidently not related to drainage, indicates the presence of copper in the underlying rock. Nor is the reverse true—that the lack of open space indicates the absence of concentrations of copper.

As a whole, vegetation is more luxuriant and trees are larger over the sediments than over granite and schist. This is probably to be attributed to the deeper soil and better subsurface drainage. No evidence is available to indicate that any particular type of vegetation is indicative of a particular rock.

Microscopic examinations of the ores have been made by C. G. Cullis, of the Royal School of Mines; F. F. Grout, of the University of Minnesota, and L. C. Graton, of Harvard University. It is now generally agreed that these

The Roan Antelope outcrop in 1925, looking northwest across the Luanshya River

Kafue River in flood

deposits are epigenetic. Before they had been explored at depth—and the most obvious feature was the persistence with which the mineralization followed definite beds—a sedimentary origin was thought possible, and there appeared to be much to suggest it. But with the information now at hand it appears that the copper was introduced into the rock after its formation and probably after it had been folded. It is necessary, therefore, to seek some explanation of why the mineralizing solutions chose the particular beds in which ore is now found. We cannot at present give a definite explanation either for this choice of beds or for the concentrations which occur at various places in the ore-bearing horizons. But certain of the facts observed are suggestive, and several factors have doubtless influenced the final result.

THE ore is found in sandstones, shales, and dolomites. At the Roan Antelope it is in what was originally a sandy shale. Here the rock is well bedded and much of the copper is concentrated on the bedding planes, but it also occurs finely disseminated between them. The bedding planes probably furnished the channels through which the solutions penetrated the rock, and the best ore is generally found where these planes are most closely spaced. The shale formation is flanked on each side by quartzites, which may have been exceedingly impervious at the time of mineralization. Also, small amounts of copper occur in the feldspathic quartzites, both above and below the ore shale. The composition of the shale was probably a determining factor, and an originally carbonaceous or calcareous nature has been suggested. Much of this formation is dolomitic at various other places, and there is a certain amount of calcite in the rock at the Roan. According to a private report, C. G. Cullis believes some of this to have been introduced as a gangue mineral, and he reports no carbonaceous matter in the specimens he examined.

Conditions are different at Mufulira, where the copper minerals are found disseminated for the most part through quartzite or sandstones. The rock is very poorly bedded. Whatever the original nature of the cement, it must have left the rock porous enough at certain horizons to allow a fairly even circulation of the mineralizing solutions. A part, at least, of the silica now cementing the quartzite was probably introduced at about the time of mineralization. In one orebody these solutions circulated in the sandstone just beneath a thin bed of very argillaceous and probably impervious material, thus accounting in part for the concentration at that horizon. In another part of the Mufulira deposit the ore-bearing quartzite is directly overlain by a hard crystalline dolomite. This rock is mineralized in part, but the copper as exposed in several drill holes penetrates the dolomite only for a small part of its width, the main concentration being in the underlying quartzite. Evidently, here the porous nature of the quartzite was a more powerful factor in the concentration than the presumably more replaceable nature of the dolomite. F. F. Grout reports a small amount of tourmaline accompanying the copper sulphides as a gangue mineral. A very small percentage of the copper occurs in small veins, accompanied by quartz and often calcite. These are seldom more than a few inches long.

At Chambishi conditions are similar, in that mineralization appears to have been controlled largely by the porosity or the replaceable nature or both of certain beds. In the western part of the concession the ore-bearing shale is a persistent formation, and mineralization is found over long distances. Along the eastern strike the dolomites and various quartzites exist as smaller lenses, and the orebodies conform, apparently, to this structure. Conditions of porosity exist in beds higher than the ore-bearing series of the lower Roan. Some of these upper beds too are very dolomitic, yet at only one place within the concession have they been found to be mineralized, and then only slightly. We are aware of the possibility, even the probability, of the existence of copper deposits in rocks other than the lower Roan, but the fact remains that none of importance has yet been found. Further, the deposits now known are all found near some point where the granite penetrates into the lower beds of the series.

The intrusive nature of this granite is undoubted. Near it the beds are often highly distorted and considerably metamorphosed. Small pegmatites, quartz veins, and granite dikes and sills occur in the sediments. But, clearly intrusive as it is, this granite has not yet been observed to penetrate any but the lower beds of the Roan Series. The methods by which this granite intruded the older schists and the sediments appear to have differed greatly. Exposures of contacts are few, but several between the granite and schist may be examined along the Kafue River. Here the schist appears to have been fractured and broken into large blocks. The granite penetrates the fractures and in some cases entirely surrounds the blocks of schist. Some of the smaller of these, well in the granite, are not oriented with the main body of schist, and have the appearance of having sunk at least a little way in the more or less fluid granite magma. Contact zones around these blocks are very narrow, and the schist is seldom highly altered for more than an inch or so from the granite, and the latter retains its coarsely crystalline texture and normal composition almost to the contact.

The contacts described above occur where the granite masses are small and often of the very acid, muscovite-tourmaline type. Around the larger masses of granite the contacts also appear to be blocky, but usually a basic fringe or contact zone exists around the granite, in which the igneous rock may be as basic as gabbro, with small exposures of rock composed entirely of amphiboles. This zone of basic rock around the granite may extend for as much as 500 yards horizontally.

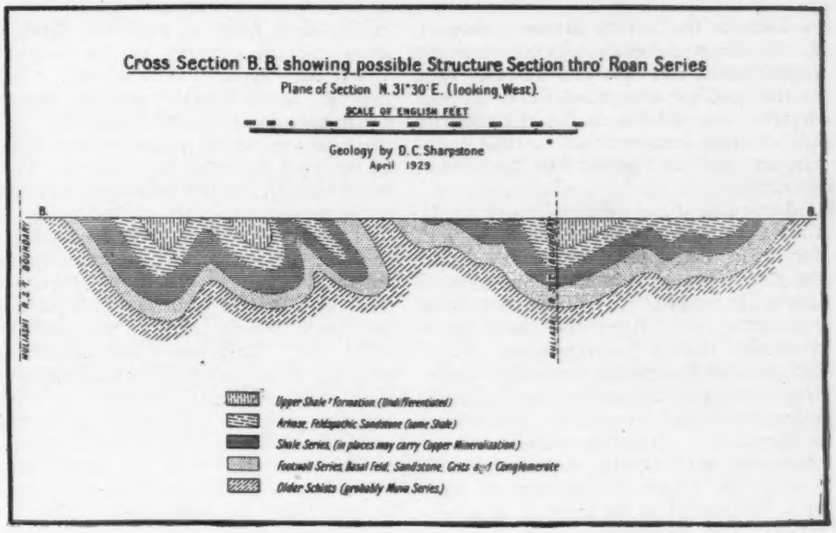
WHERE the granite penetrates the sediments, usually arkoses, of the Roan Series, this blocky type of contact has not been observed. Approaching the contact, the granite becomes finer and usually develops a distinctly gneissic texture, often but not always parallel to the beds. This, in turn, becomes more and more schistose until the rock is a muscovite or biotite schist, and one cannot tell whether it was originally igneous or sedimentary material, or a mixture of both. In this schist zone are found many pegmatite stringers, often oriented with the

schistosity, sometimes cutting across it. These become fewer and the schist gives way to rock in which traces of original bedding may be seen, and finally to more or less unaltered sediments.

Interpretation of these contacts is hampered by the fact that all so far examined have been in shallow pits, and the rock is so decomposed as to be difficult of identification. But in many pits near the contact the altered sediments have been found to be intruded, along the bedding or schistosity, by pegmatite or gneissic granite. The granite, the altered sediment, or the schist predominates.

It would seem that the intrusive mass penetrated the crystalline schists by some method of magmatic stoping, especially near the upper parts of the batholith. The crystalline rock fractured readily, and the blocks produced were easily surrounded by the fluid magma. Farther down the sides of the batholith there was more differentiation within the magma, or the differentiated outer portions were better preserved from the attack of the later and more acid portions of the same magma, resulting in the basic zones along the contacts.

NO EVIDENCE is available indicating that any stoping process occurred where the granite intrudes the sediments. The method of intrusion seems rather to have been one of gradual penetration along planes of bedding and schistosity, accompanied by a certain amount of assimilation and considerable metamorphism. This metamorphic zone may be several hundred feet in width. Whatever physical and chemical reasons are involved, the granite was evidently unable to carry this form of intrusion for any great distance into the sediments. The result of economic importance appears to be that while the great masses of schist were removed by the intruding magma, its advance was effectively stopped in most places by the sediments, and it succeeded in penetrating only the lower beds of the Roan Series.


Cross Section B.B. showing possible Structure Section thro' Roan Series
Plane of Section N. 31°30' E. (looking West).
SCALE OF ENGLISH FEET
Geology by D.C. Sharpstone
April 1929
B
B
Upper Shale Formation (Undifferentiated)
Arkose, Feldspathic Sandstone (some Shale)
Shale Series, (in places may carry Copper Mineralisation)
Footwall Series, Basal Feld. Sandstone, Grits and Conglomerate
Older Schists (probably Muva Series)

The presence of copper minerals in the associated pegmatites, and the presence of the deposits near intruding points of the granite, strongly suggest, in the light of modern knowledge of mineral deposits, a genetic relationship between the copper and the granite. And, if this be true, it explains also the apparent confinement of the deposits to the lower beds. During deformation these beds were incompetent. They adjusted themselves to folding more largely by flowage than by fracture. Mineralizing solutions, escaping from a cooling granite, found their path to the upper horizons for the most part blocked by impervious beds, and their easiest escape along the more porous of the lower intruded beds.

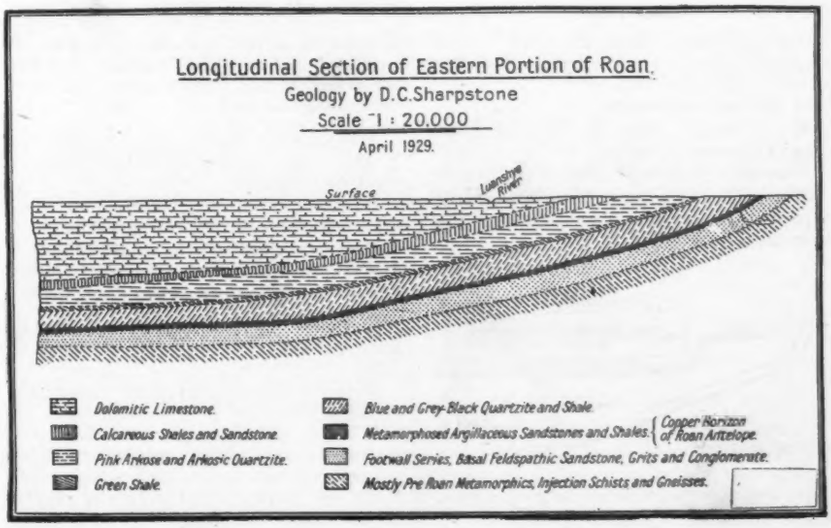
SULPHIDES which have been observed in these deposits include chalcocite, covellite, bornite, chalcopyrite, and pyrite. In the oxidized zone are found malachite, azurite, libethenite, cuprite, chrysocolla, and native copper. Black sooty oxides are common, which contain iron, manganese, and sometimes copper. Cobalt is found in traces, but the mineral has not been determined. Of gangue minerals, quartz and carbonates were evidently introduced at the time of mineralization. They form the gangue of small copper-bearing veinlets and occur, with feldspar, in the pegmatites. Calcite, a lime-magnesia-iron variety, possibly ankerite, and siderite are the common carbonates.

In depth, the zone of oxidation is variable. Sulphides occur in small amounts at the surface, and are usually predominant at a depth of 300 ft., but oxidized minerals have been found in drill holes at depths of over 700 ft. Oxidation in the deeper parts is usually confined to the hanging-wall and footwall portions of the orebody.

Chalcocite is the principal sulphide near the surface, and it occurs both in disseminated grains and small veins. It coats pyrite and is often found to contain a small core of bornite or chalcopyrite. At Mufulira it is almost always accompanied by some oxidized minerals. At greater depth, where it gives way to bornite and chalcopyrite, it occurs principally in the more or less oxidized hanging-wall and footwall portions. The same is true at Chambishi.

BORNITE and chalcopyrite are seldom found near the surface, and then only in fresh, unleached rock. At depth, where they predominate, they occur as disseminated grains, rarely in small veins, in fresh rock, only occasionally showing any signs of leaching. One or the other usually predominates, but occasionally they are intergrown. Pyrite often accompanies them in small amount, but where this mineral becomes important the copper content decreases. This has been observed to take place along the strike, but exploration has not yet been deep enough to indicate whether or not it is true with depth.

Most of the facts set forth in the foregoing are based on observations at Chambishi and Mufulira. At these places the structures are simple, and a few drill holes have been sufficient


Longitudinal Section of Eastern Portion of Roan.
Geology by D.C.Sharpstone
Scale 1 : 20,000
April 1929.
Surface
Luanshya River
Dolomitic Limestone.
Calcareous Shales and Sandstone.
Pink Arkose and Arkosic Quartzite.
Green Shale.
Blue and Grey-Black Quartzite and Shale.
Metamorphosed Argillaceous Sandstones and Shales.
Copper Horizon of Roan Antelope.
Footwall Series, Basal Feldspathic Sandstone, Grits and Conglomerate.
Mostly Pre Roan Metamorphics, Injection Schists and Gneisses.

to indicate the nature of the orebodies. At the Roan Antelope, chalcocite is the predominant ore mineral in the nose of the syncline and generally at shallow depths. Its relation to the chalcopyrite and bornite encountered in drill holes farther to the west has not been determined.

According to a private report C. G. Cullis, after examination of ores from the Roan Antelope mine, believes that the chalcocite here is most probably of hypogene origin. L. C. Graton, after examining ores from the same mine, concludes that it is supergene. F. F. Grout, after examining ores from Mufulira, concludes that most of the chalcocite is hypogene and formed at a fairly high temperature. He finds intergrowth of chalcocite with bornite associated with tourmaline, which he believes to have been introduced at the time of mineralization. But he recognizes the presence of some secondary or supergene chalcocite.

AT THE PRESENT TIME we are unable to state an authoritative solution of this problem. Certain observations have been made, however, and conclusions drawn, and these may be stated: At Mufulira and Chambishi, although the deposits have not been explored at great depth, they have been cut by drill holes at sufficient depth to show certain changes in the minerals from the surface downward. Chalcopyrite and bornite at the surface occur only in fresh unleached rock, and these two minerals increase with depth as the rock becomes less altered. They are probably for the most part primary or hypogene minerals. Chalcocite, on the other hand, is the predominant sulphide near the surface, and apparently decreases with depth. Moreover, chalcocite occurs often in that part of the rock which shows unmistakable signs of oxidation and leaching, whereas at the same place the unaltered rock contains only bornite or chalcopyrite. This is well shown in several boreholes. In the hanging-wall portion of the lode the rock is found well leached, and chalcocite is accompanied by malachite and iron oxide. Then, in the center of the lode, bornite and chalcopyrite occur, with no oxidized minerals and no chalcocite. Then, on the footwall, is repeated the zone of leaching and oxidation, with accompanying chalcocite. The same is shown on a smaller scale where cracks have been noted crossing fresh bornite-bearing rock. These cracks are sometimes more or less filled with chalcocite, accompanied by malachite and limonite.

It is rare to find bornite or chalcopyrite in any form except as a dissemination through the rock. Chalcocite, although often finely disseminated, occurs frequently in small veins and as a coating of openings along bedding planes. Chalcocite grains have often been observed to contain cores of bornite and chalcopyrite, and chalcocite has also been found coating grains of pyrite. All these facts suggest that a great deal of the chalcocite is secondary or supergene.

ON the other hand, disseminated chalcocite is not always accompanied by evidences of leaching. It may be exceedingly finely disseminated through the rock. Certain textures of bornite-chalcocite intergrowths observed under the microscope have been suggested as having formed by the unmixing of a one-time solid solution, which would indicate primary chalcocite. Certainly at the Roan Antelope chalcocite is found at relatively great depths, but, on the other hand, oxidized copper minerals are found in the deepest holes.

Some of the chalcocite in these deposits may thus well be of hypogene origin. We feel certain, however, that a great deal of it is supergene. If both be present their relative proportions remain to be proved.

(To be concluded)

PATENTS

GRINDING MILL. No. 1,718,552. June 25, 1929. W. H. Fluker, Thomson, Ga.

A grinding mill having a rotary cylinder uniformly elliptical in cross-section.

SEPARATING MICA. No. 1,716,758. June 11, 1929. J. Bland, Chicago, Ill.

A process for separating flat mica from miscellaneous material according to shape.

ACETYLENE LAMP. No. 1,716,809. June 11, 1929. B. Williamson, Ashland, Ky.

An acetylene lamp embodying a dropper of new design.

CONDENSATION OF ZINC. No. 1,715,960. June 4, 1929. F. Tharaldsen, Christiania, Norway.

A condenser for zinc vapors from electric furnaces.

PRODUCTION OF ZINC. No. 1,718,378. June 25, 1929. A. L. J. Queneau, New York, N. Y.

Zinc oxide in a molten bath is subjected to the action of a fluid reducing agent.

ORE CLASSIFIER. No. 1,715,693. June 4, 1929. B. M. Bird, Seattle, Wash.

A hydraulic classifier divided into a series of upper and lower chambers by a perforated partition.

GEOPHYSICAL PROSPECTING. No. 1,718,352. June 25, 1929. E. H. Guilford, assignor to the Radiore Company, Los Angeles, Calif.

An electromagnetic method of locating a conductive body.

REDUCTION OF COMPLEX ORES. No. 1,717,160. June 11, 1929. F. O. Kichline, assignor to Bethlehem Steel Company.

A process of selectively reducing complex ores by heating them with suitable reducing agents.

SYSTEM FOR COOLING MINES. No. 1,717,005. June 11, 1929. W. H. Carrier, assignor to Carrier Engineering Corporation, Newark, N. J.

An air refrigeration method of cooling mines.

MINERS' BOOT. No. 1,717,127. June 11, 1929. J. Toole, Kirkland Lake, Ontario, Canada.

A rubber boot with an external wearing and reinforcing pad.

ORE DREDGING. No. 1,719,442. July 2, 1929. J. F. Newsom, Palo Alto, Calif.

A process for ore dredging in which material of intermediate size is retained, following the rejection of barren fine and coarse material.

Rock Drills

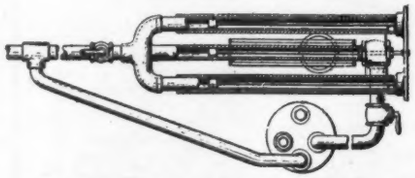
No. 1,718,430. June 25, 1929. C. F. Osgood, assignor to Sullivan Machinery Company, Chicago, Ill.

A drilling mechanism.

No. 1,718,463. June 25, 1929. M. Hardsocg, Ottumwa, Iowa.

Design for a portable rock drill.

No. 1,718,734. June 25, 1929. H. R. Drullard, assignor to the Gardner-Denver Company, Quincy, Ill.



A three-cylinder rock drill in which the extra cylinders provide a means of advancing the motor.

No. 1,718,873. June 25, 1929. C. F. Osgood, assignor to Sullivan Machinery Company, Chicago, Ill.

A hand-held drilling apparatus, one of the motors of which is of the rotary type. Operation of the apparatus is varied by means of hydraulic resistance applied to one of the motors.

EXTRACTION OF MERCURY. No. 1,718,491. June 25, 1929. F. M. Schad, New York, N. Y.

A method of extracting mercury from cinnabar ore.

PRODUCTION OF COPPER SULPHATE. No. 1,715,871. June 4, 1929. M. Speichert, assignor to Huttenwerke Tempelhof A. Meyer, Berlin-Tempelhof, Germany.

A process for producing copper sulphate solution by melting an alloy of copper, tin, lead, and antimony with sulphur. Sulphides are produced which are roasted and leached with sulphuric acid.

ANTIMONIAL ORES. No. 1,719,657. July 2, 1929. H. Goldmann, Wilhelmsburg-on-the-Elbe, Germany.

A leaching process for treating antimonial ores. A non-oxidizing inorganic acid containing a metallic protoxide which has the property of reducing antimony oxide is used.

EXTRACTING MERCURY. No. 1,718,103. June 18, 1929. W. C. Baxter, Berkeley, Calif.

Mercury is extracted from cinnabar by dissolving the ore in a solution of an alkali metal sulphide and an alkali metal hydroxide, and then passing an electric current through the solution which precipitates the mercury and separates it from the solution.

Book Reviews

Metallurgy for Engineers

PRINCIPLES OF METALLURGY. *By J. L. Bray. Boston: Ginn & Company. Pp. 569; illus. Price $5.80.*

THE author has set himself the task of writing a textbook of metallurgy in one volume, covering in that volume the reduction and refining of the common metals as well as refractories, fuels and metallography. Naturally, therefore, the book is not intended to serve the metallurgical specialist; it is necessarily too condensed for that purpose, but is meant to appeal to the engineer who is working in other fields of engineering and feels the need of familiarizing himself in a general way with the properties, methods of treatment, and limitations of common metals. Electrical engineers, the author points out, are depending on constant supplies of cheap and pure copper, mechanical engineers on alloy steels and aluminum in constructing automobiles and airplanes, civil engineers on other alloy steels for long-span bridges and skyscrapers. They therefore, will all need such a book.

The object of the book, then, seems essentially that of popularizing metallurgy among engineers, and it goes without saying that efforts in that direction deserve support. But any attempt to obtain the essence of the specialist's work and to present it to a wider circle of fellow engineers is a man-sized job, if it is to obtain the endorsement of those whose work is presented. I venture to say that many of these men will contradict some of the statements referring to their work. H. B. Lowden, for instance, will hardly be found ready to admit that his drier is of a type that has the disadvantage of producing a considerable amount of flue-dust, nor Emil Deister that the vanner is the only machine that can efficiently concentrate fine materials not suitable for treatment by the flotation process.

This volume contains many such statements that the author will hardly be able to defend successfully. Its value would undoubtedly be materially increased if the subject matter of the various chapters were scrutinized by workers in the various fields. It seems rather presumptuous on the part of a reviewer to make such suggestions, in view of the fact that, had he attempted what the author did, he would have made a very poor job of it; but he cannot repress the thought that, if Professor Bray would consider the first edition of his book as a kind of a draft which he would not hesitate to modify according to the advice of experts in the various branches of metallurgy, he would create something that ought to be of great value. RUDOLF GAHL.

STRUCTURE OF TYPICAL AMERICAN OIL FIELDS. *A Symposium by 39 authors. Tulsa, Oklahoma: The American Association of Petroleum Geologists. Pp. 510. Price $5.*

THIS volume contains 30 papers by 39 authors describing producing oil pools and districts in thirteen different states. The views expressed in the various articles represent the mature opinions of those who, by reason of personal experience and observation, are fully qualified to speak as authorities concerning their respective subjects. The book contains numerous maps and cross-sections that materially aid the reader. It has been edited and printed with the same care and in the same style that characterizes the monthly bulletin of the American Association of Petroleum Geologists.

This particular volume is the first of a series through which the association plans "to afford authoritative and modern descriptions of the structure of typical oil fields of the United States." The reviewer is glad that the stated purpose and the title have not restricted the authors to mere descriptions of structure and of the relation of oil accumulation to structure. Most of the authors have added interesting details on general geologic conditions, sand problems, oil, gas, and water characteristics, and engineering and economic problems related to the development of the areas.

To find descriptions of some of the smaller and less sensational areas is most pleasing. The rapidity with which major pools have been discovered in the United States during the last few years has served to overshadow the small producing areas which in the aggregate contribute much to our total production and are probably more typical of the "average" pool than the sensational pool. Thorough descriptions of important areas, such as Garber, that have not heretofore appeared in print despite the length of time since their discovery, are most welcome. The writer of this review was especially interested in the paper by F. H. Lahee describing the great fault line pools of the Mexia district in Texas. Though much of the material had appeared previously in shorter articles, this comprehensive and mature discussion of a unique and world-famous area will be greatly appreciated by all who are interested in petroleum production.

To the individual whose primary interest is in other lines the volume offers thorough and authoritative descriptions of representative oil producing areas. With other volumes to be published later it will form an excellent book of reference. Its value to subscribers to the bulletin of the association is substantially lessened by the fact that the association, like many other societies bringing out special volumes, has included a large proportion of articles that have appeared previously in its bulletin. ERNEST R. LILLEY.

ENGINEERING INDEX, 1928. *Vols. I and II. American Society of Mechanical Engineers, 29 West 39th St., New York. Price* $125.

These two volumes constitute the first of a new series of "The Engineering Index." According to the publisher, the volumes which preceded them have recorded but a limited amount of the engineering knowledge published in the technical press. The 1928 Index has been made much more comprehensive in an effort to correct this unsatisfactory condition. An attempt has been made to cover every phase of engineering activity so as to produce a dependable guide to the technical press of last year. The editors have also sought to present the material in such form as to enable the user to locate quickly all published data on any given subject; and to make the descriptions so adequate that the user may quickly decide whether or not the article is of any value for his purpose. An authors' index is included for the first time. In the course of preparing Vols. I and II, 1,700 periodicals have been reviewed.

KEYSTONE METAL QUARRY CATALOG, *1929. McGraw-Hill Catalog and Directory Company, 475 Tenth Avenue, New York. Pp. 443. Price $15.*

This well-known volume is a completely indexed collection of manufacturers' catalogs of machinery, supplies and equipment—for the metal and non-metallic mining, milling, smelting and refining, quarrying, cement, lime and allied industries. It is distributed by the publisher to a selected list of the operating officials of these industries who are responsible for buying, specifying and requisitioning of equipment. The information contained is presented in compact form and so arranged as to be readily assimilable.

GEOPHYSICAL ABSTRACTS No. 2. *Information Circular 6133. Bureau of Mines. Compiled by F. W. Lee. Washington, D. C. Pp. 34.*

As in the circular that preceded this one a collection of abstracts, rarely exceeding a few hundred words in length, of articles and books on geophysical methods is presented. Many of these are from foreign publications. The pamphlet concludes with an index of authors and subjects.

COMMENT AND CRITICISM

A Glimpse of Namaqualand's Mining History Since Its Discovery in 1687

To the Editor of "E.&M.J.":

Namaqualand is probably the oldest active mineral area of southern Africa. Simon van der Stel was attracted to this region by reports of great wealth of copper ores in 1687. His excursion to this extreme northwestern annex of the settlement that had then been founded at the Cape must be accounted one of the great adventures of the voyageurs of bygone days. Patterson and le Vaillant each wrote of the mineral wealth of Namaqualand. Later, Sir James Alexander journeyed through the wild region traversed by the great Gariep or Orange River and recorded the discovery of a very rich copper mine by William Josephs in 1834. A year or two later, Sir James commenced the exploitation of copper deposits in the Richtersveld, the region in which Josephs had made his find in 1834.

Ore was mined at Numees and Kodas nearly a century ago, carted by ox wagon to the Orange River, and then floated down the muddy waters of the great Gariep to a point about three miles from the mouth. Here stone houses stored the ore.

The mouth of the Orange River is heavily sand-barred. Were it not so, this river would give ready access to the interior, and the history of Namaqualand—and particularly the northern portion thereof—might have been very different from what it has actually been. The early shippers of copper from the Richtersveld had to employ Alexander Bay, but, because of transportation and water difficulties and the general inaccessibility of the country, the copper industry soon languished.

Alexander's effort to develop mining in Namaqualand appears to have stimulated enterprise. In the 'forties several prospectors adventured into the district, but not till 1852, when Phillips and King commenced mining at Springbokfontein, did any real activity in Namaqualand become evident. Andrew Wylie, geologist for the Cape government, visited Namaqualand and presented his report to Parliament in 1857. At that time several isolated copper properties were at work in southern Namaqualand and within the Great Bend of the Orange River.

After one has traveled through that country today and let one's mind go back to the conditions that obtained there in the 'fifties, when the steam engine was still a tremendous novelty and when mules and bullock teams had just begun to cart the rich ore produced at the Phillips-King mines, at Springbokfontein and O'okiep, to Hondeklip Bay, one cannot marvel at the fact that the Richtersveld mines had to bow to sheer force of circumstances and close down.

In southern Namaqualand, however, conditions were more favorable, and the continued exposure of ore in the properties around Springbokfontein, O'okiep, and Concordia led to the formation in 1862 of the Cape Copper Company. A less costly and more satisfactory route to the coast than that available via Hondeklip Bay was to Port Nolloth or Rogge Bay. At first a tramline with trucks drawn by mules was employed, but later a light railway of 2 ft. 6 in. gage, with locomotives, was constructed, and by this means much copper was shipped from Port Nolloth to Europe. Most of the ore so dispatched went to Swansea. Probably at no time in the history of the world has a greater quantity of high-grade copper ore been shipped from any port than was sent away on sailing vessels and cargo steamers from this little wind-swept settlement on the southern Atlantic. Later, the Namaqua Copper Company was formed.

The history of the Cape Copper and Namaqua Copper companies has been the history of the mining industry in Namaqualand. Cape Copper ceased to work in Namaqualand after the war. It was originally formed in 1862, with a capital of £200,000, divided into 20,000 shares of £10, of which £8 was paid up. By 1888 it had distributed dividends totaling £67 13s. 0d. per share, or slightly over an average of 37½ per cent per annum for 22 consecutive years. It then reorganized its capital, giving the shareholders 15 shares of £2 for each £8 paid-up share, thus making a capital of £600,000. From then until 1917 it paid £10 0s. 3d. per share in dividends and bonuses, or an additional £150 2s. 6d. per original £8 paid-up share. For the last 30 years of its activity the average dividend on the original share was 62½ per cent per annum. The holder of an original share, therefore, had returned to him in dividends £217 16s. 3d., plus a proportional interest in several other concerns, including the Namaqualand Railway.

The decline in output during recent years brought stagnation. O'okiep, for example, became a shell of the busy and thriving mining township that it once was. The complete cessation of operations and disposal of the Cape Copper Company's assets seemed inevitable. Its affairs were placed in the hands of an official receiver, and for some time the properties were under option to the General Mining & Finance Corporation. That option was not exercised, but almost immediately after that corporation had failed to exercise the option, American Metal stepped in. For the last three years this organization and associated companies have been opening up the properties of Cape Copper under option.

OWEN LETCHER.
Johannesburg, South Africa.

NAMAQUALAND—tucked away in a corner of southwestern Africa—has been known as a mineral area since 1687 and has produced copper since 1834. . . . Transportation was the big problem at first, but steam and the railroads converted the operations into highly profitable enterprises. . . . A decline in output after the war led to closing the mines, but interest has again been aroused by the entry of important American companies.

Columbia and the Manganese Tariff

To the Editor of "E.&M.J.":

I am quite curious as to how you got the idea that I said that the tariff on manganese "fosters no industry and depletes our too-scanty reserves of this essential raw material." In my address at the Institute of Politics at Williamstown, which appears in full in the September issue of *Mining and Metallurgy,* that statement which you attribute to me in an editorial in your issue of September 7, is plainly indicated as a quotation of a statement by Mr. Reynders at the Cleveland meeting in 1927, and the words immediately following indicate that there is a strong difference of opinion on the subject. My own statement was to the general effect that we have conflicting (almost passionate, in some cases), opinions within the mineral industry on a matter of general public policy, and that we of the industry cannot expect the public to know what is the best policy unless we can agree on it ourselves. The context of even the newspaper reports, on which you have apparently relied, seem to me to make this clear.

Considering the facilities which the New York Telephone Company provides for quickly getting in touch with a person in the metropolitan area at a cost of 5c., it seems not unreasonable to mildly suggest that you might have ascertained with more accuracy what my views really were before commenting on reports of them. The *Times,* in reporting my views, misspelled my name throughout, but that does not indicate that I have changed my name. The kind of dailies that are printed on pink paper ran an item "One or two hundred years from now we'll be getting minerals and oils from hundreds of miles underground, according to Dr. Thomas T. Read, . . ." but I did not say that, either. The question as to whether the domestic manganese industry would collapse if the tariff were removed was not touched on in any way in my remarks, and I think you must agree that the implication in your editorial that the official position of Columbia University toward the domestic mining industry is an unfair one, was wholly unwarranted. It should be quite evident to everybody that Columbia University has no official position toward the mining industry; the members of its faculty are human individuals who are fortunately accorded the right to think for themselves and are not regarded as necessarily unfair if they should venture to differ with others who are also qualified to have an opinion.

New York. THOMAS T. READ.

[Doctor Read refers to an editorial that appeared in the issue of Sept. 7, as follows:

"The first release from the Department of Public Information of Columbia University under the new professorial régime in the department of mining deals with the effect of the 'Squandering of America's mineral resources as the result of a national policy of forced overproduction and unreasonable taxation . . .'; but a short and pungent comment is injected by Dr. T. T. Read against a tariff on manganese, which, he maintains, 'fosters no industry and depletes our too-scanty reserves of this essential raw material.'

"The domestic mining industries of the United States, actual and prospective, deserve fair treatment from Columbia University. The statement that the tariff on manganese fosters no industry is not true, nor is the inference correct that the manganese industry of the United States—of infantile proportions, perhaps, but growing in technical achievement under protection—will not collapse if it be removed.

"To encompass the ruin of a domestic industry dependent on research for its success, because the utilization of the ore 'depletes our too-scanty reserves of an essential raw material,' is to make certain that the reserves will be almost valueless in the event of emergency. However, *Engineering and Mining Journal* is in agreement with Doctor Read when he states that 'The general principle involved in promoting the development of domestic supplies of mineral material has never been studied with as much thoroughness as its importance would seem to warrant.'"

Engineering and Mining Journal repeats its criticism of Columbia University in respect to an infant United States industry, and hopes that any further releases from its "Department of Public Information," will avoid obvious partiality toward powerful interests hostile to research and development of domestic manganese. The editorial was based on matter issued by Columbia University, not on newspaper reports. The official release contains nothing to indicate that the statement quoted concerning the tariff on manganese should be attributed to Mr. Reynders instead of to Doctor Read, and *Engineering and Mining Journal* feels that it was justified in accepting the report as accurate. Doctor Read's protest should be directed to the Department of Public Information of Columbia University, of the professorial staff of which he is a member; but this will not counteract the harm that has been done by misstatement.—EDITOR.]

"Apple Sauce" and Employment Reagents

To the Editor of "E.&M.J.":

I see the unkind editor again publishes a list of salaries that other people get. I once did some flotation research work and don't remember ever getting $5,900 for it. Nevertheless I was not badly paid.

A short time ago, in L. A. (short for Las Compañas de Nuestra Señora de Los Angeles), I was interviewing a man of many millions, trying to make money out of a treasure mine without working it. I stated my proposition glowingly and, as I thought, to the point. When I finished, all he said was "Apple sauce—apple sauce," and left the room, presumably in the direction of a restaurant. I had been away from civilization so long that "apple sauce" was still to me as Webster's dictionary says it is. I waited a few moments. The stenographer, understanding Spanish, and divining that I did not get his meaning, said: "He thinks your proposition is full of 'bull' or something."

Now, the professor who made up that list of salaries is an earnest worker and genuine, but the information turned in to him may have been "apple sauce." Ask an applicant for a position what his last salary was, get his answer, say inwardly "apple sauce," and then give him the much-needed job.

AMERICANO.

Somewhere in Mexico.

Precision in Technical Nomenclature

To the Editor of E.&M.J.":

Since the subject of precise nomenclature has been raised in your issue of Aug. 10, I should like to plead for a discrimination between the terms "tailing" and "residue," and that not in any merely purist spirit but in the interests of clarity of expression and avoidance of mental confusion and brain fag

First, is there any *prima facie* distinction between the words? "Tailing" is quite old in metallurgical nomenclature and is descriptive of the material at the tail end of a concentrator, the series being, "head" (or as some prefer to say, by analogy, "heading"), "middling" and "tailing." The word may also be appropriately applied to the material at the tail end of an amalgamated plate and also to the reject from the modern process of concentration by flotation. "Residue," on the other hand, suggests to the chemist the insoluble portion remaining after a material has been subjected to some dissolving process.

The second point, then, that arises is, why need we insist on any such distinction as a point in precise technical nomenclature? Surely, at some time or other, a synonymous use of the two terms must have caused at least temporary misunderstanding among some of your readers. The need for discrimination is the greater owing to the fact that "tailing," the reject from amalgamation or concentration or both, is frequently cyanided, again resulting in a rejected product, the "residue." I often have been puzzled by the question, "How much do your tailings assay?" I reply by stating the content of the mill tailing treated, but after five minutes at cross purposes I realize that the inquiry refers to the cyanide residue.

Similarly, in reading descriptive articles of mills in your valuable paper I find statements about "tailings" being high or low or what-not, and have to hunt up and down the page to find out whether the writer means the mill reject or the cyanide-plant reject.

I propose, therefore, as a contribu-

tion to the standardization of technical terms, that we confine the use of the word "tailing" to the reject from concentration processes including amalgamation and flotation, and use the word "residue" to indicate the reject or undissolved portion resulting from lixiviation processes. Correspondingly, the same material before lixiviation might be called "original" more appropriately than "head."

Thus we shall avoid the need of such explanatory expressions as "tailing heading" and "tailing tailing," or "tails heads" and "tails tails."

E. M. HAMILTON.

San Francisco.

[Mr. Hamilton's contribution raises the question as to whether or not those who should be concerned with the proper selection of technical terms can be persuaded to take any interest in the subject or to co-operate in effecting a reform. Too many engineers seem to regard "precision" as synonymous with "fussiness." Educators are apparently content to accept a confusion of ideas and a slovenly use of terms as inevitable, rather than to support what is logical or to criticize what is unscientific. One who hopes to effect a reform in technical nomenclature feels constrained to be apologetic, lest he hurt the feelings of his readers. He has to explain that he is not a purist, but merely an engineer with the engineer's distate for inefficiency. Having performed what he feels is a duty to his profession, what happens? Nothing! The younger generation of students graduate with a set conviction that theirs is the liberty of choice. The writer of today rarely indicates that he feels any responsibility toward the writer of tomorrow.

Ten years ago an inquisitive individual investigated the subject of nomenclature used in reference to intermediate and final rejects from hydrometallurgical operations, and the findings and recommendations were published in *Engineering and Mining Journal*. The article was concluded as follows:

"The alteration in the meaning of the word 'tailing' has been almost imperceptible. For a considerable time it was used to designate a material too poor to treat any further. Then came new processes. Tailings were still tailings, but they were valuable. The last word had not been spoken; the air of finality in the definition indicated a mistaken and pessimistic outlook on progress. So the use of the word has been continued in English-speaking countries to refer, in the great majority of instances, to something that would or might repay additional attention, although one product, at least, had been removed. The secondary treatment of what was previously considered valueless developed the necessity for an additional designation for the waste material finally discharged from the plant. The word 'residue' was adopted, and has been extensively used in this connection.

"In these days of complication in metallurgical treatment, the use of apt terms to designate the various products is a help to the operator and a necessity to the author. In bygone time, in the atmosphere of which our modern dictionaries are prone to linger, when stamp mills produced amalgam and débris, and when the summit of concentration achievement was reached with the single buddle, the need of an extensive vocabulary was less in evidence. Today agreement is a help in the co-ordination of impressions and experience; and this cannot be achieved when technicians disagree as to the precise meaning of the words they use.

"In hydrometallurgical literature the gold metallurgist was perhaps the first to differentiate between 'tailing' and 'residue.' This was due, probably, to the absolute necessity of distinguishing between the two products. The same development has occurred in concentration practice with reference to the re-treatment of material which was previously considered unprofitable; but concentration specialists are inclined to overwork the term 'tailing' by making it refer to all material from which concentrate has been removed, whether in the preliminary, intermediate, or final stages of treatment; or to go to the other extreme and consider it only as a waste and valueless product. If there was any indication of agreement, it would be another matter, and custom could be pleaded as a sound reason for the continued use of a term in the sense of an accepted interpretation. In the present instance there is no unanimity of authoritative opinion, although the need for harmony of expression, to facilitate reference and classification, is an obvious one.

"In conclusion, the following definitions are submitted to summarize the points raised, and for the purpose, if possible, of opening a discussion on the subject:

"Tailing—The material from which one or more concentrated or partly concentrated products have been removed, and which is available for further treatment.

"Residue—The waste or final product from a hydrometallurgical plant which, at the time of operation, is valueless as far as metal content is concerned."

The interest aroused was negligible; the result, imperceptible. *Engineering and Mining Journal* only hopes that Mr. Hamilton's appeal will have at least some effect.—EDITOR.]

Dowsing and Mental Vacuity

To the Editor of "E.&M.J.":

In the issue of May 11 I see a letter from Mr. Carl Hanssen regarding dowsing. It is hard to believe that there persists a belief in the divining rod. To me, and I think most of us, it is just so much nonsense. It may work "subconsciously" but there is no scientific evidence that it works "honestly." It will work apparently only for the favored few. There is nothing definite or positive about it. Why should it work for just the few? Mr. Hanssen has offered the explanation when he suggests that "The serious manipulator ought to work with an absolutely blank mind."

I agree with him the mind must be blank—absolutely blank!

JOHN SMEDDLE.

Bluefields, Nicaragua, C. A.

George Hearst's "Luck"

To the Editor of "E.&M.J.":

In a recent issue of the New York *American*, Arthur Brisbane, describing the State of Montana and particularly the Anaconda mines around Butte, stated that George Hearst was in that part of the country over a century ago. He said that it was a profitable ride that Hearst took across the Rockies. The story of his Comstock adventure, which appeared in *Colliery Engineer* of June, 1891, reads as follows:

The late Senator Hearst once told a newspaper man that he regarded his possession of an immense fortune as nothing less than a miracle.

"I was forty-nine years old," he said, "when the row made over the discovery of the Comstock silver mines set the whole coast wild. I had been disappointed at my work, and found myself pretty near broke. I had enough to buy a horse and the outfit, and started over the mountains from California with the boys. I wasn't feeling happy, because I'd worked and struggled and speculated a good many years, and it struck me as rather rough that a man of my age should have to start out, as I did then, like a young fellow.

"There were about ten or twelve of us in the party, and as I was blue they left me alone rather. My mustang being worn down, I stopped on the trail, put my arm through the bridle and picked out a rock to sit on. The rest of the boys rode on, but I sat there. There wasn't any reason why I should particularly; only I did. The whip I had was a willow switch I'd pulled from a tree as I rode along. As I sat there I switched the dust of the trail and thought, shall I go with them or shall I go back? I switched and switched and thought and thought. I saw behind me all the hard work I'd done, all the chances I'd taken and lost on, and felt old and used up and no good. My sense told me to turn back and make my fight where I was known. There was safety in that anyway.

"But I'd been camping night after night with the boys ahead of me, and it made me lonesome to think of parting company with them. So after switching and switching the dust on the trail, and feeling weak and human because I yielded, I mounted my horse and rode on after the party. I got to the Comstock, and in six months I made half a million dollars. That is the foundation of what I've done since.

"Now, why shouldn't I have turned back when I hesitated? It would have been sensible—conservative—to do that. But I didn't; and because I didn't, I won. If you're ever inclined to think that there's no such thing as luck, just think of me."

Wilkes-Barre, Pa. HIRAM SMITH.

Personal Notes

H. E. Wood, metallurgical engineer, has returned to his home in Berkeley, Calif.

Marcus Daly, well-known mine operator, arrived in New York City on Sept. 10, on the "Bremen."

B. F. Webster is in charge of operations for Dresser Mining, in the Silverton district of Colorado.

H. J. Scott, general manager of the Siamese Tin Syndicate, of London, is in Australia on a trip of inspection.

Joseph Clendenin, who is in charge of sales for Guggenheim Brothers, returned to New York City on Sept. 10 after a trip to Europe.

C. H. Birdseye, chief topographic engineer for the U. S. Geological Survey, has recently announced his resignation from that service.

Karl Sundberg, of the Swedish American Prospecting Corporation, has returned from a five months' trip to Europe and the Near East.

A. E. Nordland is mill superintendent at the Lackawanna plant, which has recently resumed operations. It is in the Silverton district of Colorado.

E. R. Householder, mining engineer, has completed a report on the Gold King property, in the Maynard district, in the Wallapai Mountains, Arizona.

Sir **William Peat** will be chairman of the executive committee of the Tin Producers Association, recently formed in London to stabilize the tin market.

James MacNaughton, president and general manager of Calumet & Hecla Consolidated, has been elected a director of the First Bank Stocks Corporation.

R. V. Ageton, of the U. S. Geological Survey, who has been in Washington, D. C., for the last three months, expects to return to Miami, Okla., shortly.

Dr. **C. A. Heiland** has returned from Europe and is on his way to Golden, Colo., to resume his duties as professor of geophysics at the Colorado School of Mines.

F. L. Serviss has left the Catholic University of America, at Washington, D. C., to take charge of the department of engineering geology at Purdue University, Indiana.

Roland B. Oliver, mining engineer, of Oakland, Calif., has returned from a two-years' mining exploration trip in the Ivory Coast of French West Africa and adjacent territory.

J. L. Agnew, vice-president of the International Nickel Company of Canada, in charge of operations in the Sudbury district of Ontario, is leaving for England on business.

T. Williamson has recently been appointed to the propaganda staff of the London Chilean Nitrate Committee, and will take charge of the six northern counties of England, including the Isle of Man.

George R. Tingle, formerly mill superintendent for La Fortuna Mining, at Rosario, Chihuahua, Mexico, is now in charge of mill operations for the Elkoro Mines Company, operating at Jarbidge, Nev.

Tasker L. Oddie, senator from Nevada, arrived in New York on Sept. 11, from Brazil. Senator Oddie was presidential appointee as delegate to the Pan American Highway Conference, held in Rio de Janeiro.

A. C. H. Gerhardi has severed his connection as general manager with Toric Mines, in the Alice Arm district of British Columbia, and is now engaged in the direction of Douglas Pine Gold, Thurlow Islands, B. C.

A. A. Boyd, commissioner from the government of Queensland, Australia, is now in the United States studying methods and conditions in mining districts. He was formerly in charge of operations at Mount Morgan Gold, in Queensland.

James Frame, consulting engineer, of Franklin, N. C., has been retained by the owners of a chrysotile deposit in western North Carolina, to make a study of the geology of the property.

H. B. Kingsbury, of Mullan, Idaho, has been elected president of the Independence Lead Company, incorporated recently to take over properties in the Coeur d'Alene district. Mr. Kingsley is also manager of the new organization.

E. A. Fritzberg and **John Hickey,** of Phillipsburg, Mont., attended the American Manganese Producers' Association convention, held in Washington, D. C., last week. Mr. Hickey will spend a day in Madison, Wis., on his return trip to Montana.

Ocha Potter, and **A. H. Wohlrab,** respectively mine superintendents of Calumet & Hecla Consolidated and Isle Royale Copper, have returned to the Michigan copper district from Butte, Mont., where they inspected the Anaconda mines.

W. M. Archibald, manager of mines for Consolidated Mining & Smelting, was in Salt Lake City recently, to attend a meeting called to formulate a development program for Missouri Monarch Mines, which owns property in Elko County, Nev.

Harold W. Aldrich, superintendent of the Inspiration Consolidated leaching plant, has been elected vice-president of Apache Airlines, organized to operate freight and passenger airplanes between Phoenix and the Globe-Miami district of Arizona.

N. A. Veitch, an Australian metallurgical engineer who has recently been engaged on professional work in Northern Rhodesia, is expected to arrive in San Francisco from Australia about Sept. 26 on the "Tahiti." Mr. Veitch will visit the copper metallurgical plants in this country.

H. J. Emery has resigned his position with the British Metal Corporation, Ltd., and has entered into a partnership with Bunting, Yates & Company, members of the Montreal Stock Exchange. **R. D. Hearn** succeeds Mr. Emery in charge of mining operations for British Metal in Canada and Newfoundland.

I. N. Grinyev, director of the central mines of the Soviet Southern Ore Trust, in the Krivoy Rog district, Ukraine, **A. V. Britchkin,** chief engineer of the Northern group of mines of the Trust, and **B. N. Gladovsky,** chief mechanical engineer, have arrived in this country for the purpose of studying iron ore mining and the equipment market.

H. E. Vail will continue as consulting engineer of the reorganized Lake View & Star company, which will include the holdings of Golden Horseshoe in the Kalgoorlie district of Western Australia. Mr. Vail was general manager of the old company. **J. F. Thorn,** formerly with Goldfield Consolidated, of Nevada, has been appointed general manager of the new company.

Scott P. Stewart, civil and mining engineer of Provo, Utah, has been appointed director of the Utah State Securities Commission, succeeding **H. C. Hicks,** who has resigned after more than eight years. During recent years Mr. Stewart has devoted most of his time to mining engineering, although he has been connected with several road and drainage problems throughout the state. In 1908 he was appointed U. S. Mineral Surveyor, which position he still holds. His work has brought him in contact with mines in the Tintic, Park City, Bingham, Gold Hill, and other Nevada and Utah mining districts.

OBITUARY

J. Edward Green, of Lebanon, Pa., died in Paris on Sept. 4. Mr. Green was in charge of the Paris office of Ingersoll-Rand, on the staff of which he had been a mechanical engineer for many years.

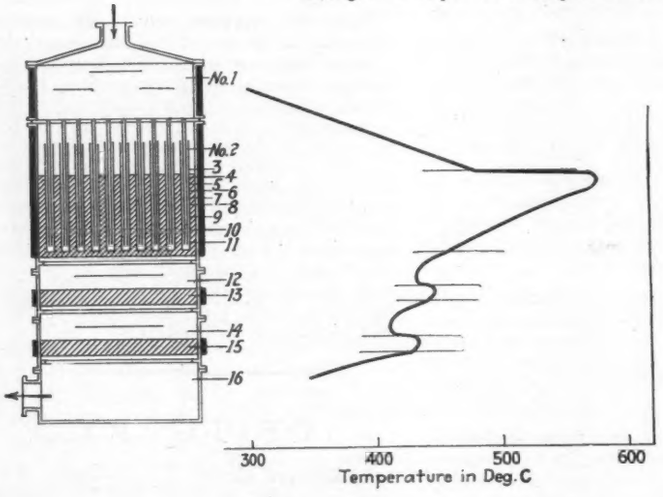
William Poole, consulting engineer of Sydney, New South Wales, Australia, who was for many years connected with Broken Hill Proprietary, died recently. He was a graduate of the university at Sydney, having received his degree in mining engineering in 1900. In 1914 he organized the consulting firm of Julius and Poole.

Dr. Etienne Bieler, deputy director of the Imperial Geophysical and Experimental Survey of Australia, died recently in Western Australia. Dr. Bieler, who was 34 years of age, was engaged in a section of the work of the survey in that state. Born in Switzerland, he was educated at McGill University, where he won the Cambridge 1851 exhibition scholarship for 1920-23. At Cambridge he specialized in the study of radioactivity, working under Rutherford. In 1923 he returned to McGill as assistant professor of geophysics, and in 1928 was appointed by the Australian Commonwealth Council for Scientific and Industrial Research to the position of assistant director of the survey.

Sulphuric Acid from Smelter Gases—A New Contact Process

FOR many years sulphuric acid has been an important byproduct in the recovery of metals from ores. Besides the gases from the roasting of pyrites in which the production of acid has been the chief object, those produced in copper smelting and in roasting zinc ores have been used for this purpose as well as the waste gases from copper blast furnaces. Under some conditions, operation of these plants has been necessary merely as a means of getting rid of obnoxious sulphur vapors, but usually such plants have been run at a substantial profit. Because of the low and variable sulphur dioxide content of the gases, and because of the presence of large quantities of dust and contact poisons, most of the sulphuric acid produced from these sources has been manufactured in lead chambers.

Fig. 1—Temperature curve of compound automatic heat-exchange converter system consisting of automatic heat-exchange converter in series with two-layer Grillo converter using 7 to 8 per cent sulphur dioxide gas



Acid of this strength is well suited for metallurgical purposes, such as the flotation of copper, lead, and zinc minerals from their ores and the leaching of waste tailing, but because most smelting plants are at a considerable distance from the main sulphuric acid markets, the shipment of acid of chamber strength in any great quantity has not been found profitable. On the other hand, the expensive purification and close control which would be necessary in maintaining plants for the production of strong acid by the contact process have in most instances rendered impossible the production of acid of this kind which could be shipped with profit to the markets. For these reasons many smelters have considered impractical the installation of the large and expensive chamber plants necessary to take care of all the waste gases from their plants and have usually satisfied themselves with making as much acid as could be disposed of in the vicinity of the plant.

Heretofore the installation and maintenance of the few contact plants designed to make use of smelter gases have required a large expenditure for the installation of expensive apparatus for purifying the gases, since these must be absolutely free from arsenic, selenium, and other substances which poison the platinum used as a contact mass. This in turn has necessitated further complications in the construction of the plant, since the gases must be cooled during the purification process and must then be reheated to reaction temperature. In the smelting of some sulphide ores, such as those of zinc, where the temperature of the waste gases is not high, this would even necessitate, in some operations, the use of heat from an outside source to attain the necessary reaction temperature.

A new contact sulphuric acid process has now been developed by the Selden Company, of Pittsburgh, as a result of the inventions of its technical director, Dr. A. O. Jaeger, in which these difficulties in converting smelter gases to sulphuric acid by a contact process are entirely overcome. By this process contact sulphuric acid can be produced so cheaply that it costs less to prepare concentrated acid and dilute it than to manufacture dilute acid by the chamber process, and at the same time the excess production of the plant can be shipped as concentrated acid or as oleum.

The new process embodies radical improvements in converter design and the use of new and non-poisoning contact masses which have been developed to overcome previous limitations in the contact sulphuric acid process.

Improvements in New Process

Dr. Jaeger's new process is based on a thorough study of the kinetic and thermodynamic requirements of the reaction used in producing sulphuric acid from sulphur dioxide gases, and permits the carrying out of the reaction in complete accordance with these requirements. The improvements include, first, a compound, automatic, heat-exchange converter system, consisting of automatic heat-exchange converters in series with air-cooled converters, which arrangement provides for a temperature gradient automatically maintained irrespective of fluctuations in flow of the reaction gases, and compensates fully for the varying conditions existing in the different parts of a converter system.

The second improvement lies in the use of non-platinum contact masses which are not affected by the gaseous poisons for platinum, such as the arsenic and selenium commonly encountered in smelter gases, and which in their conversion efficiency and durability equal or exceed the best platinum contact masses commercially available. The third improvement, which results from the use of these catalysts, is the elimination of the costly purification process which has been necessary in the use of platinum catalysts, a necessity which has rendered the adaptation of such catalysts to smelter gases almost a financial impossibility.

These three improvements have given the contact sulphuric acid process an entirely new position with respect to chamber plants. No longer must constant attendance of skilled chemical supervisors be provided in the running of such plants, and the control of temperature in the reactions, in so far as it could be effected in previous contact processes, no longer depends only on skilled manipulation and constant close watching. With these new processes, therefore, all the advantages of a chamber plant may be had in addition to the great flexibility obtainable only in the contact

process. The new process therefore makes possible, in accordance with fluctuating demands, dilution of as much of the strong acid or oleum produced to acid of chamber strength, or weaker, as may be desired, at the same or lower cost than the same acid could be produced by the chamber process, and shipment of the remaining portion to the markets. This new contact process is, therefore, destined to replace more and more the chamber process, and this movement has already begun, as one of the largest plants yet built in the United States is using the new process, diluting its contact acid to chamber strength. It was built with this purpose in mind.

The first two improvements, which are the basic causes of the enhanced efficiency of the Selden Company's process and which are about to be described, may be taken up, first from the angle of temperature control and converter design, and, second, from the standpoint of contact mass efficiency.

The catalytic oxidation of sulphur dioxide to sulphur trioxide is an equilibrium reaction. As the temperature increases, conversion equilibrium is a maximum at about 400 deg. C. for practical gas velocities, but at this temperature the reaction velocity is very low—too low for commercial production. As the temperature increases above 400 deg. C. the reaction velocity increases very rapidly, so that, for example, at 500 deg. C. the reaction velocity is about forty times as great as at 400 deg. C. At the same time, however, the percentage of conversion, as determined by the reaction equilibrium, drops.

An ideal converter system, in accordance with the kinetics of the reaction, requires high temperature in the portions of the contact mass first encountering the reaction gases, so as to provide for high reaction velocity, and the temperature should then gradually and continuously fall as the gases pass through the contact mass, the last portions of the contact mass being maintained at about 400 deg. C. In converter arrangements in which the gases pass in a vertical direction, this means that there should be a smooth vertical temperature gradient; in other words, the temperature must decrease evenly from the point where the gases first strike the catalyst. In any horizontal cross-section of the contact masses, the temperature should be uniform, however; otherwise, there will be a non-uniform utilization of the contact mass and an inadequate reaction velocity in the portions which are not maintained at the proper temperature, and this is not accomplished in the commonly used converter systems.

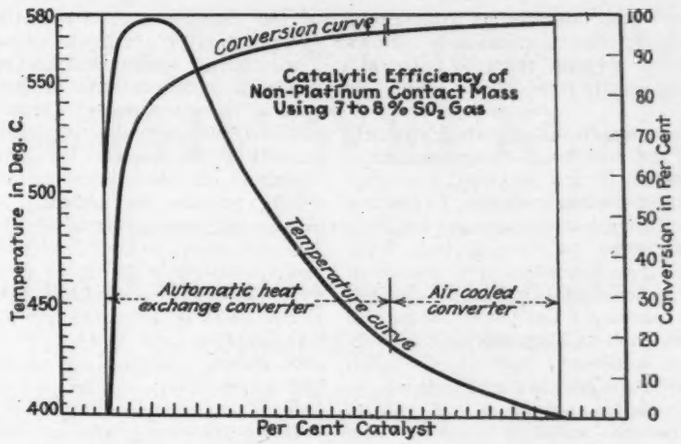


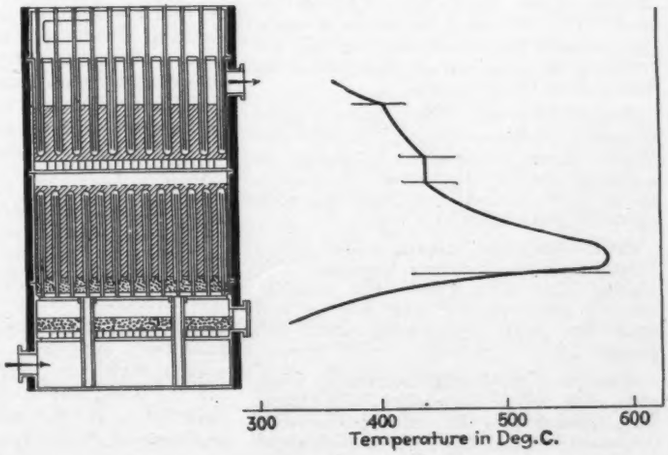
Fig. 3—Curves showing the catalytic efficiency of non-platinum contact mass using 7 to 8 per cent SO_2 gas

As shown in Figs. 1 and 2, these conditions are maintained exactly and automatically in the Selden Company's compound, automatic, heat-exchange converter systems, using their double countercurrent heat-exchange elements. These consist of evenly spaced tubes open at one end, into which other tubes are placed concentrically, extending to the bottom. The last-named tubes are supported from a tube sheet, as in ordinary converters, and the whole is inserted in the catalyst mass. The burner gases which are below reaction temperature pass through the inner tubes, reverse their flow, and pass through the larger tubes, and then down through the catalyst, and during this passage are preheated to the proper reaction temperature, at the same time automatically removing excess heat from the catalyst mass. This first mass of catalyst is supplemented by one or more layers of catalyst which are less powerfully cooled, since the heat reaction produced in these sections is not so great. The cooling effect can be obtained by uniform radiation from the converter shell or by the use of outside cooling means, such as air or cooled burner gases. To maintain a uniform temperature throughout any given cross-section of the catalyst, the openings of the inlet pipes around the peripheral portions of the converter are made smaller than those at the center, so that less cooling gas is passed through. In this way the unavoidable loss of heat by radiation through the converter shell is counteracted.

By the use of a fully compensated converter system of the double countercurrent heat-exchange type, as described, one factor of the ideal converter system—namely, uniform temperature in any horizontal cross-section of catalyst—is completely satisfied; the other factor—a smooth, vertical temperature gradient—is provided for in the new process by controlled cooling in the subsequent layers of the catalyst by means of air, steam, cooled burner gases or other cooling media. The flow of gases is controlled by thermostats, and thus the whole converter is made entirely automatic and can be run without expert supervision. These converter systems are more fully described in the Jaeger patents 1,660,511, Feb. 28, 1928, and 1,685,672, Sept. 25, 1928, issued to the company as assignee of the inventor.

The new contact masses which the company uses contain no platinum and are the inventions of Dr. Jaeger which are described in U. S. Patents Nos. 1,675,308 and 1,675,309, dated June 26, 1928; and No. 1,694,123, dated Dec. 4, 1928 (issued to the company as assignee of the inventor). These complex base exchange contact masses, containing vanadium as one of the catalytic elements, exceed in efficiency the best commercial platinum catalysts. Daily ex-

Fig. 2—Temperature curve of compound automatic heat-exchange converter system consisting of automatic heat-exchange converter in series with air-cooled converter using 7 to 8 per cent sulphur dioxide gas



perience with the large commercial installations has continuously shown conversion ranging from 97.5 to 98.5 per cent, usually over 98 per cent. See Fig. 3.

These contact masses are extremely durable and resistant to the temperatures encountered in the reaction, and they show an astounding immunity to gaseous poisons which destroy platinum catalysts in short order. Poisoning tests were made by representatives of a prominent sulphuric acid company in the United States. During these tests poisons for platinum, such as compounds of arsenic, selenium, antimony, hydrochloric acid, and hydrofluric acid, were introduced into the reaction gasses in tremendous concentrations without injuring the catalyst in the slightest, although the amount of poisons passed over the catalyst in the space of a few hours represented a weight almost two-thirds of the catalyst and several times that of the major catalytic components. The catalyst maintained its efficiency, and with regard to some of the poisons, notably compounds of arsenic, this efficiency was actually temporarily augmented by the poison. This remarkable immunity to the action of the most deadly poisons for platinum catalysts makes the new process ideally suited for use with smelter gases or with gases from the roasting of pyrites and other ores, since a chemical purification of the gases is not necessary to protect the catalyst, and the large expense and serious maintenance problems of the purification system for gaseous poisons are entirely eliminated. Plants utilizing the new processes have been successfully operated on smelter gases and the effectiveness of the processes with these gases is a well-established fact.

BULLETINS

AIR WORK—Allen Air Appliance Company, 452 Lexington Ave., New York City. Bulletin No. A-50.

CONVEYOR CHAINS—Chain Belt Company, Milwaukee, Wis. Catalog No. 330. Engineering data book.

SILENT CHAIN—Ramsey Chain Company, Albany, N. Y. Catalog No. 628. Silent chain drives.

MOTORS—Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin No. 159. Large vertical motors.

WELDING—The Linde Air Products Company, 30 East 42d St., New York City. Oxwelding aluminum and its alloys.

ELECTRIC HAULAGE—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1142. Type EW resistors.

MOTORS — General Electric Company, Schenectady, N. Y. Bulletin No. GEA-752A. Direct-current motors, Type BD.

RECORDING INSTRUMENTS — Sangamo Electric Company, Springfield, Ill. Bulletin No. 37. Narrow type HN switchboard meters alternating current.

SWITCHES—Roller-Smith Company, 233 Broadway, N. Y. City. Bulletin No. 600, describes oil circuit breakers. Twenty pages.

DRILL SHARPENER—Sullivan Machinery Company, 39 Church St., N. Y. City. Bulletin No. 72-N, describes light model drill sharpener. Sixteen pages.

MAGNETIC STARTER—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Class 13-100 non-reversing magnetic starter. Two-page leaflet.

SPEED REDUCERS—Westinghouse Electric & Manufacturing Company, Nuttal Works, Pittsburgh, Pa., single reduction mill-units. Sixteen pages.

PUMPS—Worthington Pump & Machinery Corporation, 2 Park Ave., New York City. Bulletin D-450-B1 (superseding D-315) describing Axiflo, Hiflo, and Coniflo deep-well pumps.

WATER WHEELS—The James Leffel & Company, Springfield, Ohio. Bulletin No. W203, submerged - type gate - operating mechanism, open, decked, or vacuum penstock installation.

RECORDING INSTRUMENTS — Uehling Instrument Company, 473 Getty Ave., Paterson, N. J. Bulletin No. 150. Barometer and vacuum recorder for steam turbines.

LIQUID OXYGEN EXPLOSIVE—Keith Dunham Company, 110 South Dearborn St., Chicago, Ill. Bulletin entitled "Loxite."

SUPERHEATERS—The Superheater Company, 17 East 42d St., New York City. Bulletin No. T-19, describes the Elesco multiple-loop, single-pass superheater.

JAW CRUSHERS — Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Bulletin No. 1827A, describes Superior jaw crushers for mining-machinery division.

WELDING—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1009A, describes Type WD-300A arc welder.

ALLOY STEEL—Joseph T. Ryerson & Son, Inc., 16th and Rockwell Sts., Chicago, Ill. New Nikrome bulletin. Describing a heat-treated alloy steel of guaranteed physical properties.

WATER WHEELS—The James Leffel & Company, Springfield, Ohio. Bulletin No. W204, featuring the Ford Motor Company plant, Hamilton, Ohio., where Leffel water wheels are installed.

MACHINE SHOP—The South Bend Lathe Works, South Bend, Ind., Catalog No. 90-A. This catalog, in two colors throughout, contains illustrations, descriptions, and prices of the entire line of lathes from the 9-in. size to the 18-in. size.

WATER WHEELS — The James Leffel Company, Springfield, Ohio. Bulletin No. W205. Gives a detailed description of a typical Leffel water-wheel installation, featuring the outside or exposed type gate operating mechanism.

ROCK BREAKERS, GRANULATORS, PULVERIZERS.—Best Machinery Company, 1159 Market St., San Francisco, Calif. Describing the Best primary rock breaker and pulverizer, with performance data and prices.

WELDING—Torchweld Equipment Company, 224 North Carpenter St., Chicago, Ill. Catalog No. 29. Covers complete torchweld line with cross sectional views of gas welding and cutting, lead welding, soldering, brazing, and decarbonizing equipment, general information.

RECORDING INSTRUMENTS — Sangamo Electric Company, Springfield, Ohio. Bulletin No. 78. Type N ampere-hour meters.

REMOTE CONTROL—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Circular No. 1834, entitled "Synchronous-Visual Supervisory Control."

CIRCUIT BREAKERS—Roller-Smith Company, 233 Broadway, N. Y. City. Supplement No. 1-A to Bulletin No. 580. Covers some recent additions to the line of Type EAF, small, inclosed air break circuit breakers.

INDUSTRIAL NOTES

Fusion Welding Company, a subsidiary of Chicago Steel & Wire Co., has taken over the sale of all welding rod manufactured by the parent company.

Copperweld Steel announces the establishment of a northeastern district, to be managed by G. F. Bain, with headquarters in New York.

The American Hoist & Derrick Company, of St. Paul, has appointed W. M. Cusac to its Chicago sales force. Mr. Cusac was formerly with the McMyler Interstate Company, of Cleveland.

The W. A. Jones Foundry & Machine Company, of Chicago, announces the appointment of W. C. Webb as Pacific Coast sales manager, with offices in Los Angeles.

Fuller Lehigh Company, of Fullerton, Penn., announces a new grade of chilled iron, to be called "Elverite," in honor of J. S. Elverson, metallurgist for the company, under whose direction it was developed.

Newhall Chain Forge & Iron has purchased the chain shop and other buildings of the Rensselaer Chain Works, at Rensselaer, N. Y., together with adjoining properties, to permit expansion.

Wagner Electric, of St. Louis, announces the addition of W. H. Kretz to its sales staff. Mr. Kretz was formerly with the Public Service Company, of Oklahoma, and will travel in the Southwest.

The Timken Roller Bearing Company announces that R. C. Brower, formerly general manager of the Timken Roller Bearing Service & Sales Company has been promoted to the position of assistant secretary and treasurer of the Timken Roller Bearing Company. W. H. Richardson has been made general manager of the service company. He was manager of the New York branch.

The Mine & Smelter Supply Company will build a warehouse on Second South St., between First and Second West, in Salt Lake City, Utah, this fall. The new structure is to house electrical, assay, chemical, mine hardware, and machinery supplies. It will be three stories high, and have a frontage of 125 ft., according to an announcement made by A. H. Seeps, of Denver, Colo., president of the company.

NEWS OF THE WEEK

Summary

ACTIVITY in the Park City district of Utah is greater now than it has been at any time in the history of the camp. Production is keeping up with the record set last year, and exploration work is being undertaken by two smelting companies and many independent concerns. Page 446.

* * *

Rumors that Dos Estrellas has closed down its properties in Michoacan, Mexico, are false, as operations are being continued at full force. However Borda Antigua, operating in the same district, has suspended work because of exhaustion of its ore reserves. Page 447.

* * *

Labor disturbances have caused the closing of the Chrome copper refinery of American Metal. Hope for early resumption of activity has been expressed by company officials. Page 445.

* * *

More details of the program for the Mount Isa Mines, in Queensland, Australia, have been released. Hoisting will be done through one shaft, 570 ft. deep. Page 449.

* * *

Six men lost their lives in a cave-in on Sept. 4 at the Calaveras mine of Engels Copper, near Copperopolis, Calif. Page 445.

* * *

Contract has been awarded for the construction of a 6-mile spur to the Errington mine of Treadwell Yukon, in the Sudbury district of Ontario. Page 448.

* * *

Construction of the new Noranda copper refinery in Quebec is expected to start this fall. No site has been definitely chosen as yet. Page 444.

* * *

U. S. Bureau of Mines has devised a plan whereby its studies will be made available to the industry through presentation at society meetings. This will overcome, in part, the difficulty created by lack of funds for printing. Page 445.

Anaconda Official Proves Able Spokesman for Manganese Producers

W. B. Daly Points Out That Domestic Reserves Are Sufficient for More Than 50 Years—Optimism Over Outcome of Tariff Controversy Prevails at Annual Meeting

OPTIMISM regarding the outcome of the controversy over the tariff on manganese prevailed at the convention of the American Manganese Producers Association in Washington on Sept. 9 and 10. Manganese on the free list, where it was recently placed by the Senate Finance Committee, had gained far more publicity for the producers' cause than a tariff-protected manganese could have achieved.

Recent important discoveries of manganese ore, development of ore treatment processes, and the possibility of a new outlet for manganese as an aid in agriculture were the high points of the discussions featuring the program. One fact finally stood out above all others: A huge tonnage of low-grade manganese ore awaits beneficiation in the United States. This fact had its most important witness in W. B. Daly, general manager of mines for Anaconda Copper Mining. Mr. Daly's coldly critical analysis of the case for and against the manganese producers should prove a great aid to the latter in the further course of their campaign for adequate protection.

Mr. Daly's Address

To those who assert that "there is no high-grade and very little low-grade manganese ore in the United States," Mr. Daly replied that in certain manganese properties recently discovered in South Dakota, Arizona, and Nevada, together with those on the Cuyuna Range, the existence of 150,000,000 to 200,000,000 tons of low-grade ore was attested by well-known engineers. This tonnage, when beneficiated, was sufficient to supply the United States for from 50 to 75 years. And in addition to this was the manganese in other deposits in no less than 216 locations in 34 states, which occurrences had been plotted on a map prepared by the U. S. Bureau of Mines and reproduced by the U. S. Geological Survey. In these deposits, said Mr. Daly, with proper development and the average of success usual in mining, consequential orebodies should be proven. (In some of them, as in Butte and Phillipsburg, in Montana, and in Virginia such proof has long since been gained.)

The deposits to which he had referred as being in South Dakota, said Mr. Daly, were those near Chamberlain, which are owned or controlled by the General Manganese Corporation. From these can be produced 50,000,000 to 100,000,000 tons of ore assaying 16 per cent, a statement attested by John A. Savage & Company, of Duluth.

Those deposits in Arizona (western) and in Nevada (southeastern), to which he had referred, were owned or controlled by the Chapin Exploration Company, of Kingman, Ariz. From these can be mined approximately 50,000,000 tons of 10 per cent manganese ore, a statement attested by M. C. Lake, consulting geologist, of Duluth. The owners, Mr. Daly said, would welcome an examination by the Geological Survey.

New Processes for Treating Manganese Ores

To opponents of the tariff who assert that even if large tonnages do exist, there is no known process of beneficiating the ore so as to make a product acceptable to the steel industry, Mr. Daly replied that K. M. Leute of the General Manganese Corporation had assured him as to the successful development of a leaching process for that company's ores at Chamberlain, S. D. With this process a 70-per cent product could be obtained.

M. C. Lake was again quoted by Mr. Daly, this time as having said that the Bradley ammonium sulphate leaching process had been successfully worked out with respect to the Chapin Exploration Company's ores so as to make a 65 to 70 per cent product.

The Anaconda company, said Mr. Daly, had worked out a successful flotation method which would beneficiate its rhodochrosite ores at Butte, raising their grade from 25 to 40 per cent and reducing the silica to 6 or 7 per cent. This success had trebled the reserves of these ores in Butte.

Considerable progress had also been made by the Bureau of Mines in working out methods of flotation for beneficiating both carbonate and oxide manganese ores. Mr. Daly said.

Opponents of the tariff also asserted

that the cost of beneficiating would be prohibitive, the speaker stated. From his personal knowledge and other information, however, he could state definitely that the processes described were simple and inexpensive.

Manganese Industry Must Have Time

Opponents of the manganese tariff also asserted that domestic producers had done nothing to stimulate production since the tariff was enacted, remarked Mr. Daly. In answer, he cited numerous cases to show how much time and effort in the way of research had been required to bring well-known copper producers to their present stage of operation. He also pointed to other similar examples in the zinc, oil and steel industries, finally declaring, "When I consider the trials and tribulations of these industries and the time required to work out their many problems, and when I consider the progress made in a few years by the manganese industry, I am forced to the conclusion that this last-named industry has made far more rapid strides than the others."

That Conservation Theory

Still another claim made by opponents of the manganese tariff is that if ore reserves exist in this country they should be conserved for war purposes, said Mr. Daly, in concluding. This was best answered, he said, by stating that if the analysis of the first claim be correct, namely that the reserves in this country are sufficient for 50 to 75 years and probably longer, then there is nothing to worry about at this time. The conservation theory is further overcome, he said, by the fact that the history of mining has demonstrated that with proper development work in mining operations the tonnage ultimately disclosed has usually been many times the tonnage first anticipated from the showings on the surface.

The producers' plea for a duty of 1½c. per pound on ores containing 25 per cent or more of manganese, with graded protection for lower-grade ores, was reiterated by Mr. Daly in closing. If this relief be granted, the manganese business would grow to be one of the country's important industries, he thought.

The Proceedings in Brief

Conditions in different manganese districts of the United States were described briefly by representative speakers at the opening session of the convention. Those taking part included Richard H. Brown, of New York; John H. Cole, E. A. Fritzberg, L. L. Savage and John Hickey, of Montana; L. B. Miller of Cleveland; G. P. Goodier, of Colorado; Dr. G. W. Grasty, of Virginia; Col. George W. Steele of New York; E. F. Goltra of St. Louis; W. H. Kemler, of Tennessee; M. C. Lake, K. M. Leute and Mr. Daly.

Mr. Cole told of the recent progress of the Domestic Manganese & Development Company of which he is president. Since Feb. 15, 1929, it has shipped 19,000 tons of sintered rhodochrosite ore and expects to ship 43,000 tons this year. The present plant is able to produce annually 70,000 to 75,000 tons of a sinter analyzing 56 per cent manganese and higher, provided a market can be secured. Col. Steele, president of the Brunswick Terminal & Securities Company, which controls the Georgia Manganese & Iron Company, said that the latter company's new plant at Cartersville, Ga., would be ready by Oct. 15 and that by Nov. 1 production could be started at a rate of 150,000 tons a year. A concentrate running 42 to 45 per cent manganese would be produced. The life of the deposit, at the rate of production quoted, is estimated at fully 30 years.

Papers of note on the program, which cannot be summarized here for lack of space, were: "The Use of Manganese in Agriculture," by Dr. Oswald Schreiner, of the Department of Agriculture; "The Bradley Process," by Wilson Bradley; "Flotation of Carbonate and Oxide Manganese Ores," by F. D. DeVaney and J. Bruce Clemmer of the Bureau of Mines Station, Rolla, Mo.; "Heavy Liquid Separation," by Adrian Nagelvoart, Delaware Chemical Engineering Company; and "New Processes," by Prof. A. T. Sweet, Michigan College of Mines.

H. A. Pumpelly presided at the opening session. At this time J. Carson Adkerson, president of the association, addressed the members. Senator H. F. Ashurst of Arizona was toastmaster at the banquet (the scene of Mr. Daly's address). Senator Schall of Minnesota and Senator Dill of Washington made short speeches on this latter occasion. Senators Wheeler and Hayden were also present.

Officers Re-elected

Officers of the association were re-elected. Mr. Adkerson thus will continue another year as president. Nine new directors were elected to the board, those previously elected being retained. The nine are:

K. M. Leute, president, General Manganese Corporation, 428 Murphy Building, Detroit, Mich. Leslie L. Savage, president, U & S Mining & Development Company, 501 Fifth Avenue, New York. James W. Gerard, 57 William St., New York. Col. George W. Steele, president, Brunswick Terminal & Railway Securities Company, 165 Broadway, New York. Wilson Bradley, president, Bradley-Fitch Company, Deerwood, Minn. C. L. Berrien, general superintendent of mines, Anaconda Copper Mining Company, Butte, Mont. G. P. Goodier, president, New Mexico Copper & Mining Company, Denver, Colo. Homer C. Chapin, Chapin Exploration Company, Chicago, Ill. M. C. Lake, geologist, Duluth, Minn.

Chrome Refinery Closed by Labor Dispute

Operations at the Chrome copper refinery of U. S. Metals Refining, American Metal subsidiary, were suspended on the evening of Sept. 9. A dispute with the labor force caused the shutdown. The company took action to prevent a strike from disrupting operations when the furnaces were not banked. No ill feeling is said to exist between the workers and the company, however, and no guards are being maintained at the plant during the shutdown. An early resumption of operation is expected. The Chrome plant has a capacity of about 40,000,000 lb. a month, and treats blister from United Verde, Cerro de Pasco, International Nickel and other companies.

Construction of Noranda Refinery to Start This Fall

Official announcement has been made in Quebec City that construction of the Noranda copper refinery will probably start this fall and officials hope that the foundations will be completed before winter. If these expectations are fulfilled, the refinery will be ready for operation early in 1931. No statement has yet been made as to the location of the plant, but the Premier of Quebec has stated that directors of Noranda have definitely made up their minds to build it in that province. Several sites were investigated in and near Montreal and engineers are now examing sites near Quebec City and Levis. The Premier also stated that a zinc plant will probably be built later in conjunction with the copper refinery.

California Rand Sells Mine to Klipstein

California Rand Silver has sold its property at Randsburg, Calif., to H. W. Klipstein, who is said to represent the H. W. Gould Company, of San Francisco. The sale price is given as $50,000 which, with the proportion of taxes and insurance already paid, involved a total price of $53,000. It is expected that the property will be opened to leasers. The sale was announced to stockholders of the California Rand Silver on Aug. 31, 1929. California Rand Silver produced about $13,000,000 from the mine but during the last year has been compelled to shut down through lack of ore.

Moscow Silver Shaft Now Below 1,500 Ft.

Sinking of Moscow Silver shaft, in the Star district, near Milford, Utah, has passed the 1,500 level. Drifting will be started on the 1,600 level. The company is driving, either on contract or lease basis, four development headings and shipping about a carload of ore weekly. A drift is being extended on the 1,565 level on the contact of the blue and white limestone. Ore is being taken from a raise from the 1,565 level.

Gold Hill Drifting on New Ore at 400 Level

DRIFTING is now under way on the 400 level of the Gold Hill mine, 5 miles north of Round Mountain, Nev. The crosscut from the shaft struck a vein 4 ft. wide at this depth, and drifting in two directions showed 20 ft. of ore at last report, with both faces still in ore. On the 225 level, the vein had been drifted on for 282 ft. and showed widths ranging from 3 to 6 ft. On the 300 level, very little drifting has been done as yet, although the vein was struck in crosscutting. The ore is of rather high grade and seems to be getting richer with depth.

Officials and directors of Tonopah Belmont purchased the Gold Hill property from E. H. McMurray and Charles Taylor. J. K. Kitto is president of Gold Hill Mining. Horace A. Johnson, superintendent of Tonopah Mining, is also manager of Gold Hill.

Bureau of Mines to Present Papers at Society Meetings

A PLAN under which more reports on U. S. Bureau of Mines studies may be made available to the industry has been devised. Where arrangements can be made, reports that cannot be printed for lack of funds will be presented at meetings of societies most interested. Copies of such papers will be sent in advance to a few members particularly familiar with the subject, so that they may present their comments and criticisms and lead any discussion that may develop at the meeting.

For years, the Bureau of Mines has been unable to secure sufficient funds to print other than the more important of its papers. To meet the situation created by the lack of printing funds, the Bureau has been mimeographing many of its reports. There remain, however, many reports of value to the industry which cannot be distributed and are available only to those able to consult them at the Bureau's office in Washington. As a result, much valuable information reaches only those who are in a position to visit Washington or who maintain a representative in the capital. Under the new plan of having papers discussed at meetings of mining organizations, an additional amount of the Bureau's product will be available.

Seneca Increasing Reserves

Seneca is steadily increasing its reserves in area near Nos. 1 and 2 shafts of its mine in Michigan. The footage of ore being developed in the several drifts is encouraging and the work is being pushed with all possible speed. Shipments to the mill are averaging about 500 tons daily and the yield is holding around 25 lb. of refined copper per ton. Seneca is only in the development stage and production cannot be substantially increased until openings are further advanced. In No. 1 shaft the plat and loading pockets have been cut at the No. 10 level and cross-cutting to the vein is under way. In No. 2, the No. 17 level is opening up well to the north. When this level is under No. 3 shaft a raise to the No. 13, or bottom level, will be cut to determine the character of intervening ground.

Suit Started Against Arriba Gold Fields

E. O. SINNARD, Marie K. Anderson and Catherine Sinnard, of Denver, Colo., have filed suit in the Denver district court against Arriba Gold Fields, Ltd., alleging that the sale of stock by that company is fraudulent and that the concern is not even a legal entity. At the same time, Lawrence Tamme, state bank examiner of New Mexico, has filed a protest, asking that the company be denied use of waters from the El Rito and Potrero creeks for mining and milling purposes because of its failure to obey the blue-sky laws. The Arriba concern, organized in Denver as a "common law trust" by H. M. Little, Arthur J. Chapman, and Ross R. Thompson, claims to own an immense gold orebody in New Mexico. An intense advertising campaign for sale of the stock has been under way for the last year or so. In its issue of Dec. 29, 1928, *Engineering and Mining Journal* published an editorial attacking the claims of the company. Requests to retract the statements made therein have not been heeded.

Six Killed by Cave-in at Calaveras Mine

At the Calaveras mine of Engels Copper Mining, near Copperopolis, Calif., seven men were trapped by a cave-in of a stope on Sept. 4, 1929, on the 1,550 level of the mine. Only one man, Ompre Valle, was rescued alive but injured. The body of Ygnacio Felix was recovered but a 24-hour fight to save the life of H. Mendez ended in failure as the victim died when being removed. Four men are still unaccounted for and are believed to be dead. They are W. E. Bixler, stope foreman; Joe King, Gonzalo Gonzales and an unknown Serbian. The Calaveras property was only recently taken over by Engels and was being placed in operation when the accident occurred.

Arcadian Resumes Sinking

Arcadian Consolidated, operating in Michigan, has resumed sinking in its New Baltic shaft, now bottomed at 1,700 ft. The shaft will be lowered 200 ft. Arcadian ground is showing a tendency to be more regular and more consistently mineralized with depth.

Central Patricia to Start Intensive Underground Work

RESULTS of diamond drilling on the Central Patricia in the Crow River district of Ontario have convinced the directors that they have a mine. It has been decided to curtail further drilling and to concentrate on underground work. A shaft is being started by hand which will be carried to a depth of 50 ft. and during the coming winter a plant will be put in and the shaft carried to a depth of 500 ft. with levels at 250 and 500. One of the two drills used on the Central Patricia is now working on the N.A.M.E. property to the east and the other has been moved to the Cockshutt property adjoining Central Patricia on the west.

Louisiana Oil Well Hits Sulphur Deposit

Jefferson Lake Oil has struck a deposit of sulphur in drilling its first well in the caprock over the Jefferson Island salt dome, in Lake Peigneur, La. Caprock was struck at 618 ft. depth, and sulphur at 666 ft. The deposit is 207 ft. thick. Geophysical surveys with the seismograph and torsion balance indicate a potential area of 600 to 700 acres of thick caprock and potential sulphur-bearing rock. The well in which the sulphur was discovered is 1,800 ft. from the north edge of the dome. Nos. 2 and 3 wells, now drilling, are 200 and 800 ft. northwest of No. 1 well.

Wright-Hargreaves Improving

Wright-Hargreaves, operating in the Kirkland Lake district, is gradually pulling itself out of the hole. Mine developments continue favorable and the ore reserve position is being steadily improved. The management has now reached the opinion that it will not be necessary to sink below the 2,200 level for the next few years as known veins are developing in a favorable manner and some of the older sections of the mine continue to yield increasing amounts of good ore. By better stoping methods higher grade ore is being sent to the mill and profits are running around $30,000 per month. Mill tonnage is being held at 400 to 450 tons a day and it is not expected that any consideration will be given to further production increase.

Empire-Star to Build New Cable Tramway

At the Empire-Star Mines, Grass Valley, Calif., 80 stamps are in operation at the Empire mill and preparations are being made to install a cable tramway between the North Star shaft and the mill. In the meantime ore from the North Star mine is being trucked to the mill.

Park City More Active Than at Any Other Time in Its Career

Utah District Center of Exploratory Campaigns by Two Smelting Companies and Several Independent Concerns—Silver King and Park Utah Con. Still Furnish Bulk of Camp's Output

GAIL MARTIN
Special Salt Lake City Correspondent

IN its sixtieth year, the Park City mining district of Utah is more active than at any previous time. Production is close to the high record attained in 1928 and the attempt to make new mines was never more keen. On all sides of the old camp new companies are conducting systematic programs of exploration. In addition to the several independently financed mining companies, two smelting companies have taken up large blocks of ground. International Smelting has begun actual development work and American Smelting & Refining is conducting geologic surveys. Interest in the district is so pronounced that as far away as Kamas, 15 miles from Park City, sedimentaries are being explored in an eastern projection of the Park City mineral zone.

No one can explain why this boom did not materialize ten years ago, following the development of the Park Utah orebody east of the main camp in what was then virgin ground. Perhaps miners were waiting for one of the large companies to start things going. Certainly the factor most responsible for the present activity has been the entrance of International Smelting, Utah subsidiary of Anaconda Copper, into the district following its success in opening up the North Lily mine in the Tintic district. Before starting operations, International Smelting had its staff of geologists making surveys in the district for a whole year to determine the possibilities of extending the productive area.

The first favorable indication noted was the intense bleaching of the surface andesite in Nelson gulch. Ordinarily, this characteristic is concealed by the foliage of heavy undergrowth but in the spring and fall the fact that the andesite, commonly ranging from blue to gray when unaltered, has been bleached white, is readily apparent. This was the first favorable clue in a country whose geologic features have been masked by erosion. Several strong fissures were found that carried quartz, iron, and some silver, copper and gold. A study of the limestone outcrops caused geologists to believe that these measures belonged to the Thaynes formation just above the Woodside shale that overlies the ore-bearing Park City limestones of Pennsylvania age. Numerous pebble dikes, similar to those with which the North Lily orebody at Tintic is associated, were discovered and in these fragments of shale and limestone that indicated the existence of the ore-bearing sedimentaries, beneath the andesite.

Acreage was accumulated until today the International directly or through its subsidiaries controls 12,000 acres including the Park Premier, the Park Nelson and Park Konold groups. Park Premier in turn controls Park Central, Park Cummings, Park Empire, Park Berg and East Elkhorn. Churn drilling and underground development is under way at several points. The Victory tunnel of Park Premier, now 1,000 ft. long, is being extended northeast along the contact of porphyry and limestone to crosscut the formation and eventually develop Park Nelson, Park Konold, and Park Empire. Three 350-kva. transformers, a 650-cu.ft. Ingersoll-Rand compressor, office, warehouse, and blacksmith shop have been erected at the mouth of the tunnel, which is about a mile east of Keetley, the Park Utah community at the mouth of the Ontario No. 2 drain tunnel.

Five churn drill holes have been put down, three on Park Premier ground, one on Park Konold, and one on Park Nelson. That in Nelson gulch struck the limestone at 600 ft. One hole in Park Premier cut limestone intruded by porphyry sills. Two holes evidently were sunk in porphyry dikes. The fifth is being drilled near the Park Konold shaft to ascertain the depth at which the sedimentary horizons lie. Activity of American Smelting & Refining's western mining department in the Park City district has been confined to geologic surveys of holdings north and west of Silver King Coalition, on the west side of the camp, and of the East Utah, lying east of Park Utah on the east side.

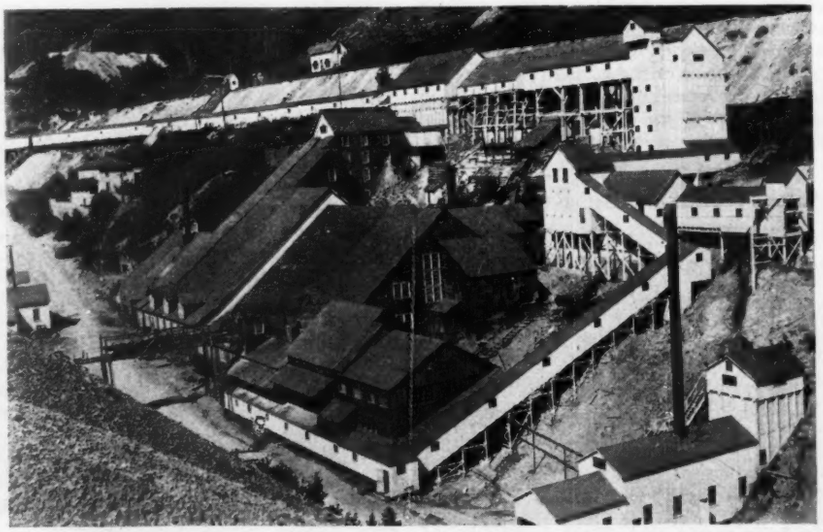
Production of the district, totaling 181,039 tons of ore and concentrate for the first six months of the current year, comes from three main sources: Silver King Coalition Mines, Park Utah Con., and New Quincy. The first two have been shippers for many years, either directly or through the mines now included in the merged groups. New Quincy started large production last year and paid its first dividend this May.

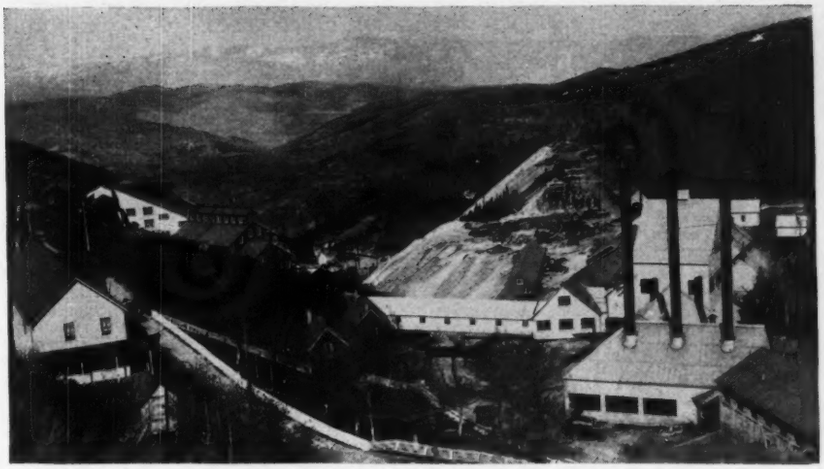
The last eight months have probably been the most prosperous in the history of Silver King Coalition. Mill recoveries have made a significant advance and the average value per ton of ore shipped will exceed the record of 1928 which was $81.36 per ton for 50,280 tons total output. High-grade as well as low-grade ore at Silver King Coalition is put through the flotation mill. This year, only one lot of crude ore has been shipped.

Many improvements have been installed in the mill. A concrete dewatering and settling tank, 120 ft. in diameter, has been built. New McIntosh cells and blowers have been added to treat the tailings. Another unit to clean concentrate has been provided. Other cells have been put in at the head of the mill. Production is averaging 19,000 tons of ore a month, one third of which comes from the Silver Hill area to the south and the old Silver King area to the north. The greater part of production is coming from the Silver King bed, lying just above the Janney quartzite of the Park City formation about 150 ft. above the Ontario quartzite. Four thousand tons of concentrate is shipped monthly, 2,800 tons being lead concentrate and 1,200 tons zinc concentrate.

Silver King Western Mining & Milling, headed by the same interests controlling Silver King Coalition, which owns 4,000 acres adjoining it to the west, has started preparations for developing at depth a territory that has received little attention previously. A 1,000-cu.ft. Ingersoll-Rand compressor is being installed at the portal of the Silver King Consolidated tunnel, from which exploration will start. Trans-

Mill at the Judge unit of Park Utah Consolidated





Surface plant of Silver King Coalition

formers have also been put in, and a fireproof building, 40x60 ft., erected to house the compressor, blacksmith and machine shops, and office.

Production of Park Utah Consolidated Mines, has ranged from 4,200 to 5,000 tons weekly of crude ore and concentrate throughout the current year. Metal production is about evenly divided between the Park City and Park Utah units. On Sept. 9, G. W. Lambourne. president of the company, announced that the regular quarterly dividend of 20c. a share will not be paid in the fourth quarter. High operating costs and delays in opening up the orebody on the 1,950 level of the Park Utah unit are given as reasons for the failure to continue dividends.

Installation of three new Byron Jackson centrifugal pumps, with a capacity of 2,700 g.p.m. each, in the Park Utah unit with motors on the 1,800 level and pumps on the 1,950, has been followed by development on the 1,950 level to open up the downward extension of the orebody at 1,800 ft.

The three pump columns of the new pumps have been set in a special pump shaft, sunk 25 ft. from the No. 2 shaft. Water is conveyed from No. 2 shaft to No. 1 shaft, a distance of 1,600 ft., in a 24-in. wooden stave pipe where it is delivered to a 4,500-g.p.m. Cameron pump, protected by a concrete bulkhead. Only 18 ft. above are two Cameron pumps with a capacity of 2,750 g.p.m. each and one with a capacity of 1,000 g.p.m. These pumps have four speeds, automatically controlled by floats, while the Byron Jackson pumps can be run on a number of different speeds. The new pumping unit allows for the handling of a continuous flow of 5,000 g.p.m., which can be increased appreciably in case of emergency as there are spare units in reserve. At present, 4,600 g.p.m. is being handled. An outstanding feature of this operation has been the efficiency of the new station. Since its installation, there has been no trouble with water, and the virgin territory to be explored is evidently being drained rapidly. Where 3,000 g.p.m., was handled on the 1,800 level, only 300 g.p.m. is being pumped today.

Development on the 1,950 level has been purposely delayed by the management so that no big flows should be developed and an emergency needlessly created. Drifting on the main fissure, on the 1,950 level has cut heavy mineralization. Opening up of the oreshoot in its downward rake is expected soon.

At the Judge mine of the Park City unit, the damage caused by the fire on June 1 is being repaired rapidly. The hoist, which was unharmed in its concrete and steel hoist room, has been operating steadily. Before Oct. 1, the new 92-ft. steed headframe should be installed and by Nov. 1, the brick and steel shafthouse will probably be erected. In the Park City group, some highly important exploration is being done under the Bonanza flat region in the Middle vein at its intersection with the Park City formation farther to the west than previously developed. Exploration in the Ontario mine, east of the Great fault is also being continued.

Production and earnings of the New Quincy mine have registered a steady increase during the summer. Shipments have increased to 200 tons daily, which bring a net smelter return of about $25 to $30 a ton. Net earnings have increased from $50,000 net in July to $90,000 in August and in September the management estimates earnings will be $125,000. The second dividend of 10c. a share, or $140,000, is to be paid on Sept. 27. A continuation of this record for some time to come is seen by the management. Ore developments have been favorable and reserves are being increased.

At Park City Consolidated, adjoining the Park Utah, three shifts are employed. A highly mineralized formation is being prospected. Recently, on the 400 level another strong fissure was cut in the Ontario quartzite.

Mayflower Mines Corporation has completed a fine surface plant and is driving an 8x7-ft. 10-in. tunnel to prospect the Mayflower, Park Bingham and Park Galena groups at depth. An occasional shipment is being made from the Park Galena.

Park King, adjoining the Park Utah, is prospecting a strongly mineralized fissure in the Ontario quartzite, believed to be the eastern extension of the Park Utah fissure at 300 ft. Park Standard is prospecting the contact of the Park City formation and the Ontario quartzite as well as the Silver King bed. The Park Kaiora is running a tunnel in a search for the projection of the Valeo fissure. At the Sphinx, Copperopolis, Star of Utah, and other properties prospecting is going on.

New Business Weekly Makes Appearance

The first number of a new McGraw-Hill publication—*The Business Week*—was issued on Sept. 7. In an announcement, Malcolm Muir, president of the McGraw-Hill Publishing Company, Inc., says:

"Swiftly, intelligently, tersely, it tells the week's business news, and the news of business. The distinction is not fine-spun. Business news impinges upon business from outside—news of the tariff, of the reparations settlement, of crops. News of business originates within business—news of developments in management technic, of improved production processes, and (outstanding these days) of changes in marketing methods.

"The whole story of the week is set forth in compact limits, a study in the fine art of saving the reader's time. Nothing irrelevant is included; nothing really important is omitted.

"There follows a digest of the significant statistics, the wheat sifted out of that overwhelming chaff-storm of figures that sweeps down upon the business man from all points of the compass.

"Few facts have intrinsic interest. It is their meaning which concerns men; their relation to other facts. *The Business Week* never will be content to be a mere chronicle of events. It aims always to interpret their significance."

Dos Estrellas Has Not Shut Down

Several New York newspapers printed a dispatch last week to the effect that Compania Minera "Las Dos Estrellas," operating near Tlalpujahua, State of Michoacan, Mexico, had closed down, throwing about 3,000 men out of employment. A telegram to H. E. Nyberg, manager of the operation, however, disclosed that the company is operating full force although in difficulties because of the low-grade ore now being handled. "Las Dos Estrellas" is a silver-gold producer.

However, Borda Antigua y Anexas, which operates in the same district, and which ships its entire output to the Dos Estrellas plant, was closed down on Aug. 31 because of the exhaustion of its ore reserves. Borda Antigua employed about 200 men and shipped on an average of 150 tons daily. Operations were resumed in 1923, as completion of a railroad to the mine enabled the company to reduce costs.

L.S.M.I. Meeting in Copper Country Highly Successful

THE largest attendance in recent years featured the twenty-seventh annual meeting of the Lake Superior Mining Institute, held in the Michigan copper district, Sept. 6 and 7. Over 240 members registered, including many visitors from the Michigan, Wisconsin, and Minnesota iron ranges, Chicago and Cleveland. They professed to find much to learn both in mining methods, as shown in trips through the district, and in hospitality.

At the business meeting, held after the banquet at the Onigaming Yacht Club on Sept. 6, John H. Hearding was elected president for the coming year. Mr. Hearding, an official of the Oliver Iron Company, of Duluth, is a charter member of the Institute. As vice-presidents George M. Cannon, of Iron River, and A. H. Wohlrab, of Houghton, were named; and as managers, D. S. Cavan, of Vulcan, Wilbur Van Evera, of Crosby, and Mark Elliott, of Virginia. A. J. Yungbluth, of Ishpeming, and J. E. Nelson, of Negaunee, remain as secretary and treasurer. The 1930 meeting will be held on the Minnesota ranges.

The retiring president, W. H. Schacht, general manager of the Copper Range company, summarized local conditions. Although no new mines of importance have been opened up in the last two decades, and the old ones are becoming both deeper and leaner, the district may look forward with confidence, he said, because of lower costs which result from better mechanical loading underground; the use of high-pressure air in drilling; improved metallurgy, particularly the use of flotation, and better smelter practice. The secretary read 51 applications for membership in the Institute, which were favorably acted upon, bringing the total membership over the 400 mark. The treasurer's report showed a balance on hand of $10,118, a slight deficit for the year. The titles of eighteen papers that will appear in the Proceedings of the Institute were read.

Following the business session, a series of five-minute talks was called for by the toastmaster, James MacNaughton, president of Calumet & Hecla Consolidated. T. M. Broderick described the C. & H. company's program of geologic research, which has culminated in the publication by the U. S. Geological Survey of Professional Paper 144, "The Copper Deposits of Michigan." Efforts to increase drilling efficiency in C. & H. mines were detailed by Ocha Potter, mine superintendent. Attempts to use air at 200-lb. pressure led to explosions; at 150 lb. it was possible to drill twice as fast as at 80 lb., but drills wore out much too rapidly. By co-operation with the manufacturers it is hoped to develop a drill that will "stand the gaff." C. H. Benedict, chief metallurgist of C. & H., summarized metallurgical developments. Adaption of flotation to amygdaloid fines by the Fahrenwald process is the greatest advance in the treatment of these ores since the ball mill came into use; its value is proportional to the richness of the ore, as finer grinding is commercially possible with the richer ore. The aggressive safety campaign at the Champion mine, which has reduced accidents to one-third of what they were two years ago, was described by Albert Mendelsohn, general mine superintendent of Copper Range. "Our aim is to make the stopes as safe, orderly, well-kept, and comfortable a place in which workmen may spend their eight hours a day as is possible," he said.

The toastmaster next called on some of the visitors. Dr. Alfred C. Lane, of Saginaw, put in a plea to save waste in the state's potentially great oil fields by supporting a state survey and legislation to check overdrilling. William Kelly, of Vulcan, a past president of the A.I.M.E., suggested that members of the two Institutes, having so much in common, might attend each others' meetings. Donald Gillies, of Cleveland, stated that the relative prosperity of the steel and copper industries has been inverted from what it was, and that the former, despite the lowest ore-production costs in history and improved metallurgy, may soon be obliged to copy copper's methods in concentration and marketing. W. O. Hotchkiss mentioned the great importance of the Lake Superior mining industries, and the value of co-operation as evinced in meetings of the Institute. A. D. Chisholm, of Ironwood, and F. J. Webb, of Duluth, voiced similar sentiments.

The Quinn-Harrison washing plant of Butler Brothers

Butler Brothers Improve Mesabi Plant

IMPROVEMENTS made at the Quinn-Harrison washing plant of Butler Brothers, near Naushwauk, Minn., include addition of 80 units of McLanahan stone jigs. These were moved over from the abandoned Mary Ellen mine, near Biwabic, and placed in operation this spring. The jigs receive the concentrate discharge from 25-ft. log washers. With this additional operation the concentrate product can maintain a grade of 10 per cent and under of silica, with an iron dried content of about 58 per cent. Rock refuse from the jigs, which is piled by a belt conveyor, makes a crushed stone product suitable for building and repairing roads.

In addition to these changes a new process is being tried out to improve the concentrate discharge from the bowl classifier. Only a small unit is being installed for test purposes. If the results are satisfactory, the process may be adopted by other range washing plants.

Will Resume Work at Almeda Mine in Oregon

After thirteen years of inactivity, caused by litigation, work will soon be resumed at the Almeda copper and gold mine, near Grant's Pass, Ore. Wearea Mining, headed by P. J. Lonegran, of Grants Pass, has acquired the property. Almeda Consolidated Mines, formerly owner of the mine, built a 100-ton furnace in 1908. This was operated intermittently until 1913, when six carloads of matte, worth $40,000, was shipped. Since 1916 only a limited amount of development work has been done.

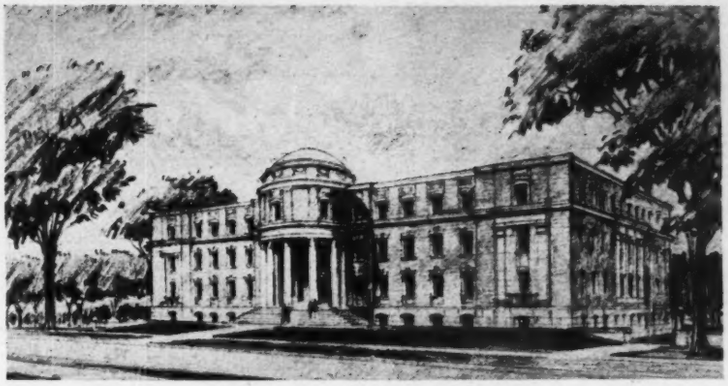
Underground workings consist of drift adits on five different levels, spaced 100 ft. apart, and a vertical shaft. Their total extent is about 6,000 ft.

Award Contract for Spur to Errington Mine

Contract for the construction of a spur railroad from the main line, near Chelmsford, Ont., to the Errington mine of Treadwell Yukon, in the Sudbury district, has been awarded to the Dominion Construction Company by the Canadian Pacific Railway. The spur line will be 6 miles long and will cost about $150,000. It is expected to be ready by Dec. 1. About 50 men are now at work at clearing the right of way. This line will afford an outlet for lead and zinc concentrates from the 250-ton pilot mill now in operation.

Bagdad Increasing Force

Bagdad Copper expects to increase the operating force at its property at Hillside, Ariz., from 80 to 150 men immediately. About $1,400,000 has been spent by the company in development of the property, reported to have ore reserves of 30,000,000 tons of ore averaging from 1.25 to 1.62 per cent copper. The company has a patent on a process for extracting the copper from sulphide ores by roasting and lixiviation.



The proposed new mineral industries building at Penn State

More Details Released on Mount Isa's Mining Program

IN THE program of operations for the first years of production at the Mount Isa mines, in Queensland, Australia, all of the ore from the three developed lodes—the Black Star, the Black Rock, and the Rio Grande—will be treated simultaneously. Mining will be carried on by both open-pit and underground methods. For the underground work, a hoisting shaft is being sunk from the top of a hill, near the mill and railroad yards, to a depth of 570 ft. To this shaft the ore will be transported by electric motor over haulage levels at a depth of 350 ft., connecting with the Lawlor shaft on the Rio Grande lode, the O'Doherty shaft on the Black Rock, and the Davidson shaft on the Black Star. The level from the Lawlor will connect with that at the O'Doherty, and the combined level will converge into the main haulage level from the Davidson leading to the hoisting shaft. At this shaft, below the haulage level, an ore bin 70 ft. deep will be sunk, and from this bin the ore will be fed automatically into the skips in 10-ton loads.

On the Black Star lode, the upper part of the carbonates, which persist from the surface to a depth of 180 to 200 ft., will be mined by a series of glory-holes, situated 200 ft. apart. By this means operations will be carried right to the footwall on the east side and to the edge of the overburden on the west side. The remaining carbonate ore, lying between the glory-holes and the hanging-wall, will be mined by caving methods. The carbonates and the sulphides below will then be treated concurrently. For the present it is intended to mine only three glory-holes.

The entire milling plant has been designed and is being erected under the personal supervision of J. M. Callow, president of the General Engineering Company of America. The smelter will be below the mill on the hill from which the hoisting shaft is being sunk. At the collar of this shaft, the ore will be tipped into bins and then carried by a gravity tramway on the northwest side of the hill to the crushing plant. Fine ore will go to other bins and thence to the grinding mills. It will then pass into thickeners to remove surplus water, and from there into the flotation cells. About eighteen flotation cells will be provided for the carbonate section and twelve for the sulphide. There will be two forms of concentrate from the sulphide ore—lead concentrate and zinc concentrate. The lead concentrate from the carbonates and sulphides will be mixed together and will be pumped over the hill to the filters on the eastern side, near the railway yards. From the filters the concentrate will be conducted to the roaster, where the sulphur will be eliminated. They will then pass through storage bins into the smelter below. The resulting lead bullion will be sent away to be refined. No arrangements have been made yet regarding the treatment of the zinc concentrate.

Will Start Treating Tailing at Golden Horseshoe in 1930

Treatment of tailing from the Golden Horseshoe dump, in the Kalgoorlie district of Western Australia, will start early in 1930 if the machinery is delivered on time, according to F. H. Hamilton, chairman of Golden Horseshoe Estates. A plant with a capacity of 1,200 tons of tailing daily is now under construction. The plant will cost about £35,000 to build. It will treat tailing averaging 8s. in gold per ton at an average estimated profit of 1s. 6d. per ton. The dump, which is more than 250 ft. high in places, is estimated to contain 2,000,000 tons of tailing.

Tom Reed Orders New Pump

In preparation for sinking the Tom Reed shaft, at Oatman, Ariz., to 1,500 ft., the company has constructed a concrete pump sump on the 800 level and has contracted for a Worthington horizontal triplex station pump which will be installed on the 1,500 level. The pump will have a capacity of 730 g.p.m. under a 1,500-ft. head and will cost about $30,000. It will be 25 ft. long, 16 ft. wide, will weigh 81,000 lb., and will be driven by a 300-hp. motor. To finance the shaft-sinking the directors voted to increase the capital stock of the Tom Reed company by 500,000 shares.

Mineral Industries to Get New Building at Penn State

PLANS for the immediate construction of a new mineral industries building at Pennsylvania State College, near Bellefonte, Pa., have been announced. Excavation on the west campus has begun. The new Penn State mineral industries building will be the largest academic building on the campus and will be on the north edge of the Armory Field, facing the men's dormitory quadrangle. It will be built of red brick with white stone trim.

The four floors will contain a large number of laboratories, classrooms, and offices to care for all instruction and research work in geology, mineralogy, geography, oil and gas production, mining, quarrying, metallurgy, and ceramics, or clay and sand products. College officials hope to have the building ready for use when college opens in September, 1930.

Howey Hits Vein at 625 Ft.

At Howey Gold in the Red Lake district of Ontario three new levels are being opened up between the 500 and 1,000 levels. The only crosscut to intercept the vein to date is at 625 ft. At this point drifting is proceeding east along the vein, which shows good widths. Ore of a grade of approximately $10 per ton is indicated. This is higher than the average of the mine. All excavations for mill buildings have been completed and nearly all the foundations are in. Timber for the super-structure is arriving on the ground and work is proceeding ahead of schedule. Over 100 men are at work on the power transmission line. Practically all material for this work is on hand and a good deal of it has been distributed at points along the right of way.

Amulet Drills Continue to Hit New Ore

Continued drilling on the new "F" orebody of the Amulet mine in the Rouyn district of Quebec, shows increasing amounts of high-grade copper ore. One of the last diamond drill holes to be completed showed 5-ft. sections of 8, 10 and 12 per cent copper, while one hole showed a total of 55 ft. of high-grade ore. The dimensions of the orebody determined to date are about 250 x 100 ft. with an average thickness of approximately 30 ft.

North Cananea Deepens Shaft

Deepening of the three-compartment main shaft at the North Cananea mine, in the Cananea district of Sonora, Mexico, is planned by the company. The shaft is now bottomed at 380 ft., and will be carried down to 500 ft. Drifting is underway on the 200 and 350 levels. The shaft is in silver-lead ore between these two points. About 35 men are employed.

MARKET AND FINANCIAL NEWS

Arsenic Situation Shows Improvement

ARSENIC has been in good demand recently, most of the producers reporting excellent business from the insecticide manufacturers. The boll weevil was sufficiently active in the southern cotton fields to make widespread use of calcium arsenate necessary, with the result that stocks of the compound were depleted and hurry calls were sent in by the manufacturers for more of the raw material—white arsenic. Also a good tonnage has been booked for delivery over the next six months, in anticipation of the 1930 seasonal demand.

The price seems to have been uniformly 4c. per lb. for large lots, the demand not having been sufficient to make any stringency in the market. Some talk has been heard of the advisability of quoting a slightly higher level but until there is a greater dearth of supply no advance seems likely. United States statistics released on Sept. 6 by the American Bureau of Metal Statistics follow, the data being given in tons:

	1929	
Crude:	June	July
Production	2,452	1,444
Deliveries to refiners	1,150	1,071
Deliveries to consumers	1,214	536
Stock at end of month	2,161	1,998
Refined (99 per cent):		
Production	917	812
Stock at end of month	3,709	3,305

The proposal for tariff protection on arsenic, sponsored by some domestic mine owners with whom arsenic is an important product, was not acted upon favorably by the Congressional committees, so there seems no likelihood of any change in price being brought about by this means. The large smelters were not behind this move. For them, a tariff would have tended to shut out the production from their Mexican plants, which must be disposed of as a nuisance even though there is little or no profit at current market levels.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78

	1927	1928	1929
January	100.46	97.54	106.86
February	100.01	96.73	110.37
March	100.84	96.22	122.71
April	98.63	97.14	116.36
May	96.41	99.05	110.03
June	95.55	100.16	109.66
July	95.42	99.69	109.58
August	97.25	99.85	109.81
September	96.01	100.53	.....
October	95.36	102.34	.....
November	96.22	103.83	.....
December	98.30	104.28	.....

Keeley Silver Reports Decline in Profits

Keeley Silver Mines, operating in the Cobalt district of Ontario, reports profits for the fiscal year ended Feb. 28, 1929, of $109,170, compared with $272,564 in the previous year. Cost of production per fine ounce of silver produced was 53.11c., compared with 35.25c. in the preceding year. This increase resulted from the material decrease in production and the large development program. During the year, 684,997 oz. of silver and 100,889 lb. of cobalt was produced, having a total value of $475,504. In the previous year, 994,582 oz. of silver and 92,962 lb. of cobalt was produced, having a total value of $632,727.

NEW MEXICO produced gold, silver, copper, lead, and zinc to the value of $18,815,863 in 1928, as compared with $15,662,076 in 1927. Most of this increase resulted from the higher value and output of copper, which was 89,854,646 lb. in 1928 and 74,251,863 lb. in 1927. Gold production also increased, from 29,241 oz. to 32,912 oz., but silver output dropped from 890,083 oz. to 827,793 oz. Lead declined from 16,052,855 lb. to 15,610,501 lb. and zinc increased from 59,603,000 lb. to 62,406,000 lb.

SONS OF GWALIA, operating in Western Australia, made a net loss of £4,341 during 1928. The 30-stamp mill treated 121,058 tons of ore and 37,388 tons of sand and slime during that period, from which production was £130,294. Working costs were 20s. 11.45d. per ton of ore milled, and 4s. 0.65d. per ton of slime and sand milled. Increased tonnage of ore handled and the larger percentage of oxidized minerals have enabled a reduction of 3s. per ton in working costs.

ALASKA JUNEAU in August, 1929, mined and trammed to mill 341,950 tons from which estimated results were $317,000, or 92.7c. per ton, and operating expenditures $176,000, or 51.47c. per ton with operating profit of $141,000, or 41.23c. per ton. Other expenses and accrued charges totaled $17,100, leaving a surplus of $123,900 for the month.

Current Statistics of Production and Stocks of Copper, Lead, and Zinc

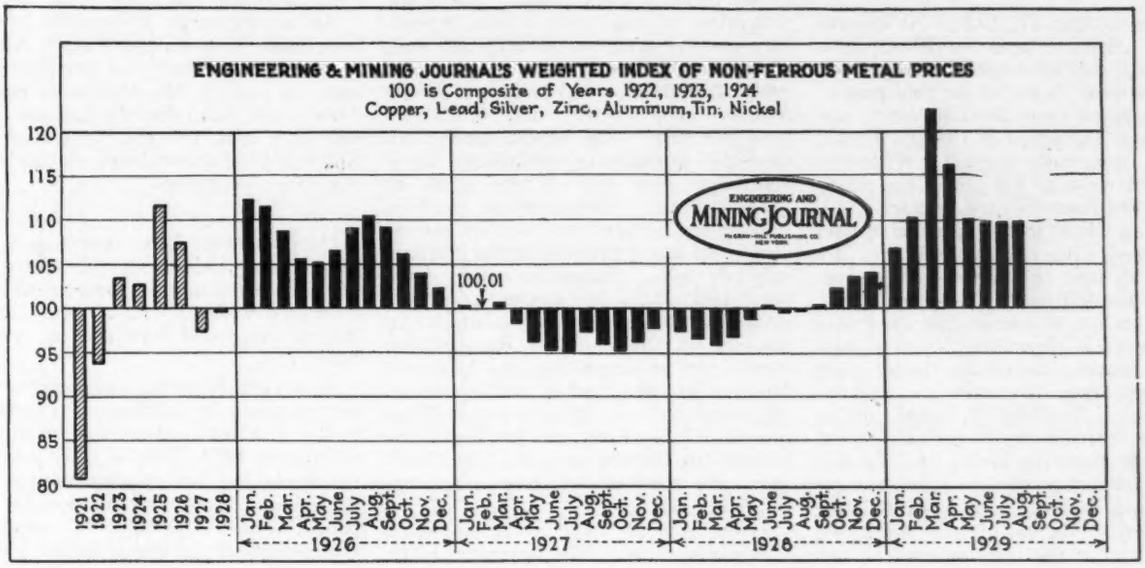
Data from American Bureau of Metal Statistics

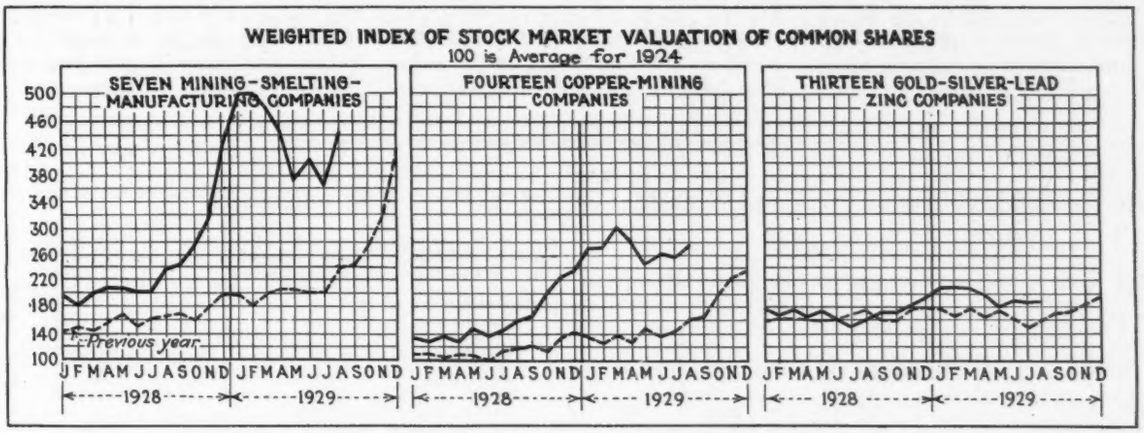
Figures Represent Short Tons

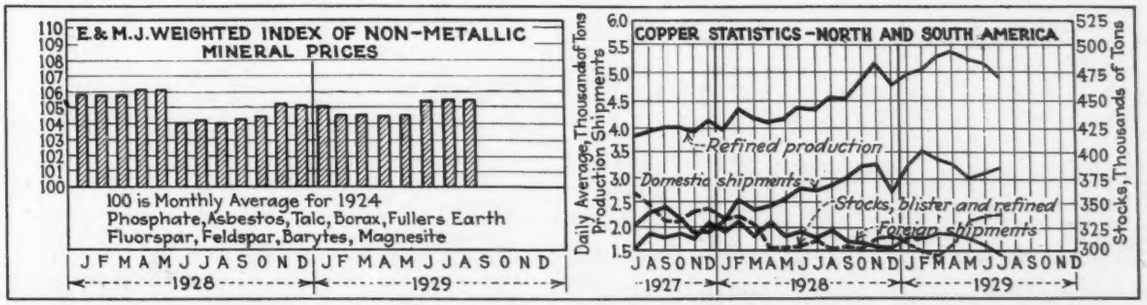
	1927	1928					1929						
COPPER—North and South America	Average	April	May	June	July	Average	Jan.	Feb.	March	April	May	June	July
Production, refined, daily average	4,045	4,094	4,169	4,367	4,358	4,448	4,983	5,049	5,276	5,378	5,219	4,630	4,952
Domestic shipments	68,737	72,234	79,103	81,436	82,245	81,955	100,135	98,771	105,860	99,051	93,743	95,258	98,720
Foreign shipments	53,489	64,989	56,738	57,067	56,785	57,185	57,054	50,150	59,946	57,708	55,123	48,461	40,204
Stocks, blister and refined	335,311	291,985	291,743	294,172	296,002	300,771	307,959	296,298	295,309	311,003	332,641	334,621	337,199
LEAD—United States and Mexico													
Production, smelter, daily average	2,513	2,208	2,345	2,470	2,219	2,514	2,656	2,559	2,617	2,720	2,792	2,777	2,737
Production, U. S. mines, daily average	1,798	1,671	1,661	1,717	1,570	1,785	1,891	1,723	2,118	2,083	2,067	1,925	1,874
Imports into U. S. A.	13,451	10,314	12,439	14,505	14,272	12,757	22,924	9,551	8,383	7,115	6,944	9,412	.....
Stocks, smelter and refinery	156,878	161,207	159,375	162,274	158,919	160,511	156,182	160,597	158,683	156,888	162,255	173,612	.....
ZINC—United States													
Production, daily average	1,681	1,783	1,723	1,694	1,642	1,693	1,604	1,720	1,790	1,822	1,837	1,708	1,756
Domestic deliveries	45,811	46,517	49,818	49,780	49,510	48,301	47,677	51,057	56,267	56,558	56,614	47,973	46,570
Exports, slab zinc	3,468	2,620	2,148	1,709	2,145	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Exports, ores and dross	4,424	155	361	268	221	453	545	165	483	308	358	266	.....
Stocks	37,602	44,759	45,225	44,468	42,210	44,333	45,418	40,620	37,962	34,588	33,826	36,932	44,122
World Production Rate (Daily Average)													
Copper	4,543	4,881	5,046	5,215	4,942	5,236	5,767	5,968	6,219	6,561	6,229	5,802	5,631
Lead	4,514	4,868	4,774	4,392	4,170	4,976	5,037	5,068	5,176	5,418	5,440	5,467	5,264
Zinc	3,910	4,352	4,248	4,131	4,013	4,271	4,231	4,357	4,448	4,357	4,528	4,483	4,386

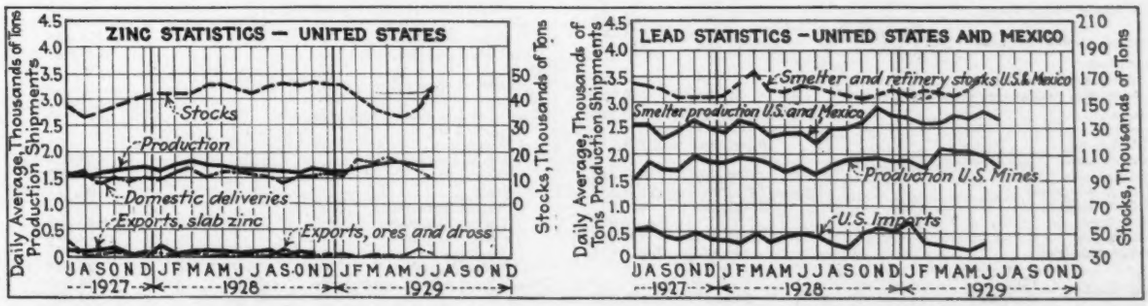
(a) Withheld pending investigation of government reports.

E. & M. J. Statistics of the Mining Industries









London Financial News

By W. A. DOMAN
Special London Correspondent

LONDON, Aug. 27, 1929.—As regards mining affairs, copper in Rhodesia is occupying the most prominent position at the moment. Some of the "big people" have returned from their holidays, and an autumn campaign in the share market has apparently started. Whenever there is a move to lift prices, the magic words "ore reserves" are broadcast, figures of an almost astronomical character being used. No one can say they are wrong, though occasionally their correctness is questioned. All familiar with mining realize, of course, that the extent of reserves is dependent, so far, upon drilling results. Boreholes, though good indicators, may overstate as well as understate. So long, however, as reports are current that American capital is being put into the companies, and that the present prices of the shares are not significant, so long, apparently will the public buy. The position is something akin to that of the International Nickel, in the United States and Canada, except that dividends, with respect to Rhodesian coppers are still in the clouds. The climb in prices is persistent, and every little setback brings in fresh buying.

The technical report on the Kansanshi mine of Rhodesia Katanga to which I made brief reference last week, is now in the hands of the shareholders. This mine differs from other Rhodesian properties in that it is a lode deposit. Ore reserves are given as 1,371,510 tons, containing 88,924 tons of copper and over 22,500 oz. of gold, or, about 6½ per cent copper, and 0.32 dwt. gold per ton. The report points out that the estimate is incomplete, as it represents only part of the mine, at shallow depth. Development work is not sufficiently advanced to allow the inclusion of any copper from the graphite sulphide beds. Numerous shafts have been sunk, and a fair amount of underground work has been accomplished. An advance in the price of these shares would not be surprising, as American interests are reported to be desirous of obtaining control. In addition, as Tanganyika Concessions and Zambesia Exploring are known to have large holdings, the number of free shares is relatively small.

Good reports have come to hand concerning the Nile-Congo Divide (Sudan), in which Tanganyika Concessions holds a large interest. Some day the concession may prove of great value, but at present little can be done, as water is scarce, there is no timber, little labor is available, and the property is far removed from all railways.

The tin magnates are becoming distinctly cheerful again, and one, largely interested, predicted a price of £250 by the end of the year.

An arrangement is reported to have been made between the leading Australian and American lead producers for sales of lead on the European market. This would mean that the London interests that now sell the Australian and Spanish product will act similarly for American producers.

DOME MINES, LTD., operating a gold property in the Porcupine district of Ontario, for August produced $317,727 compared with $320,626 in July, $383,361 in June and $315,850 in August, 1928.

MOHAWK MINING, operating a copper property in Michigan, reports net profits of $10.11 a share for the first six months of 1929. This is after allowing for taxes but before depreciation and depletion. Copper production in this period was 12,708,620 lb., compared with 7,449,038 lb. which is the average for the corresponding period over the last ten years. Production costs have been reduced to 6.027c. a pound, as compared with 7.623c. a pound in 1928, which was formerly the lowest record in the company's history.

Imports and Exports of Ores and Metals in July, 1928 and 1929

Compiled from U. S. Department of Commerce Records

In Pounds, Unless Otherwise Stated

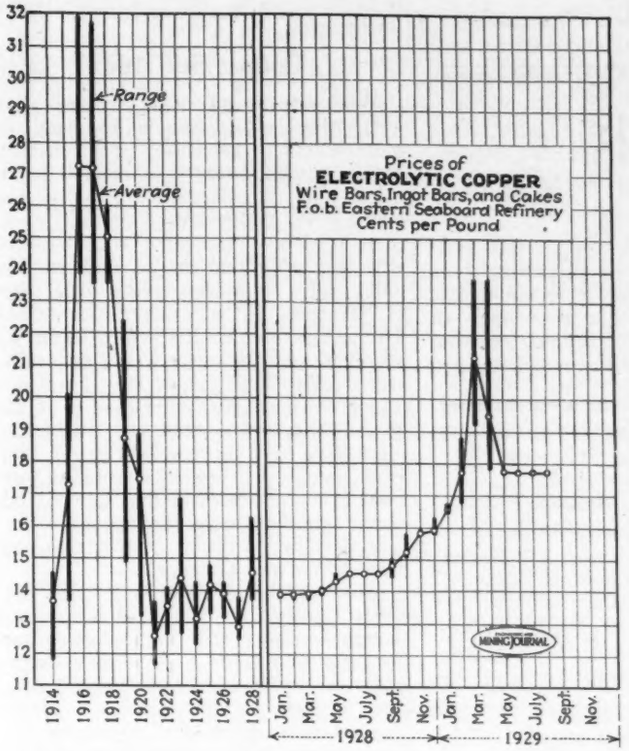
Imports

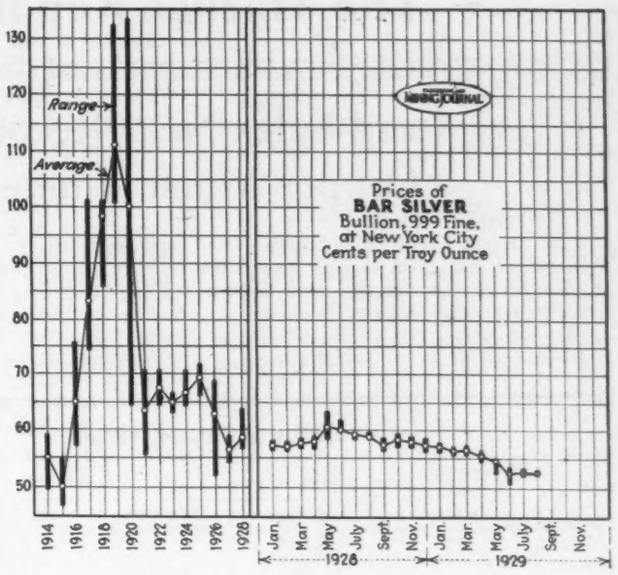
	July 1928	July 1929
Antimony		
Ore, Gross weight	248,155	55,944
Ore, Antimony content	154,557	36,364
Copper		
Ores, copper content	4,701,333	8,946,068
Concentrates, copper content	4,392,835	7,731,170
Regulus, coarse metal, cement copper	110,710	51,880
Imported from:		
Spain	623,521	994,666
Canada	2,117,064	5,518,621
Mexico	1,952,915	3,092,990
Cuba	2,655,450	
Chile	1,593,285	2,592,067
Peru	71,870	117,219
Other countries	188,773	4,413,555
Unrefined converter copper in pigs, bars, and other forms	60,706,795	29,706,981
Refined copper	5,891,102	13,354,333
Old and clippings	1,862,566	1,523,309
Composition metal	7,000	
Brass, old, for remanufacture	815,234	1,588,815
Lead		
Ore and matte, lead content	1,688,529	7,322,722
Bullion or base bullion	26,855,400	16,598,349
Pigs and bars, old and scrap, lead content		700,009
Babbitt, solder, other forms, Gross weight	222,490	392,293
Babbitt, solder, other forms, Lead content	99,248	148,103
Type metal, antimonial lead, Lead content	85,899	524,742
Type metal, antimonial lead, Gross weight	111,994	614,070
Manganese, tons		
Cuba, manganese content	130	54
Other countries, manganese content	21,447	48,406
Pyrites, tons	38,306	42,710
Tin, ore, tons	5	41
Bars, blocks, pigs	10,688,806	12,367,557
Imported from:		
Netherlands	1,480,640	851,475
United Kingdom	1,032,941	2,327,834
British Malaya	7,962,328	471,635
Hongkong		56,000
Australia	67,200	33,600
Other countries	145,697	8,627,013
Zinc		
Ore, zinc content, Free	150	
Ore, zinc content, Dutiable	685,823	198,900
Blocks, pigs, and other forms, old		55

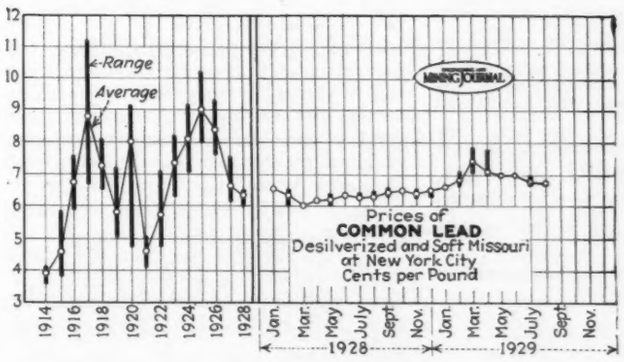
Exports

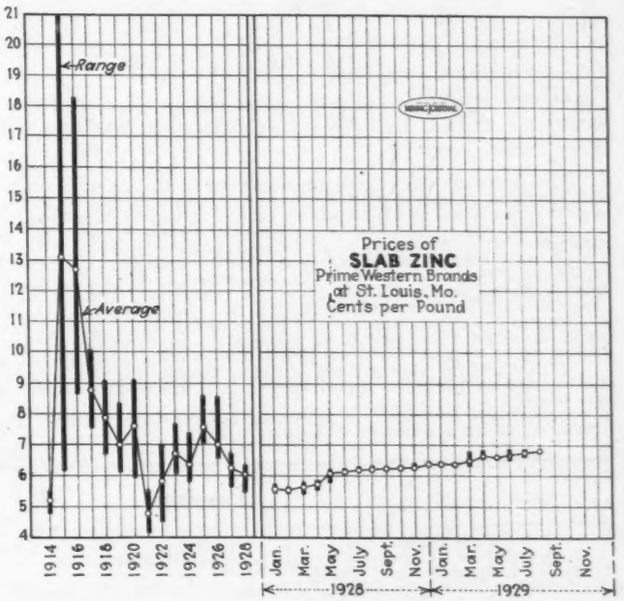
	July 1928	July 1929
Copper		
Ores, composition, concentrates, unrefined	312,549	33,136
Refined, copper in ingots and other forms	80,174,168	56,897,586
Exported to:		
Belgium	6,729,519	3,926,603
France	10,612,858	9,390,583
Germany	14,660,470	12,855,465
Italy	17,418,719	5,225,480
Netherlands	5,345,270	1,624,586
Spain	223,996	33,663
Sweden	2,265,418	3,531,146
United Kingdom	16,972,813	13,071,663
Other Europe	984,057	529,361
Canada	1,063,966	4,510,177
British India	56,000	473,678
China, Hongkong, and Kwantung	78,501	896,000
Japan	3,471,226	227,033
Other countries	291,355	602,148
Old and scrap	4,551,312	1,660,472
Pipes and tubes	332,236	245,321
Plates and sheets	635,675	138,332
Rods	6,691,476	7,256,691
Insulated copper wire and cables	1,489,583	1,824,059
Lead		
In pigs, bars, and other forms		
From foreign ore	1,098,350	1,147,138
From domestic ore	16,355,389	6,852,280
Exported to:		
France	224,068	118,638
Germany	5,960,360	
Netherlands	728,275	
Sweden	952,434	1,703,190
United Kingdom	3,585,088	1,400,426
Other Europe	952,827	853,751
Brazil	224,257	224,105
Other South America	292,620	613,651
China, Hongkong, Kwantung	448,432	56,021
Japan	3,865,907	2,913,357
Other countries	219,471	116,279
Other lead manufactures	1,826,920	1,170,779
Zinc		
Ores and concentrates, tons		2
Dross	438,729	1,069,604
Cast in slabs, blocks, and pigs	4,290,488	1,606,824
Exported to:		
Belgium		22,385
France	448,033	168,034
Germany	419,383	25,225
Italy	1,120,171	112,076
Netherlands	52,777	87,909
United Kingdom	123,259	112,018
Other Europe	112,062	402,827
Japan	1,593,835	
Other countries	420,968	676,350
Sheets, strips, and other forms	770,543	1,006,339
Dust	63,671	414,750
Other zinc manufactures	152,286	195,709

Metal Price Curves

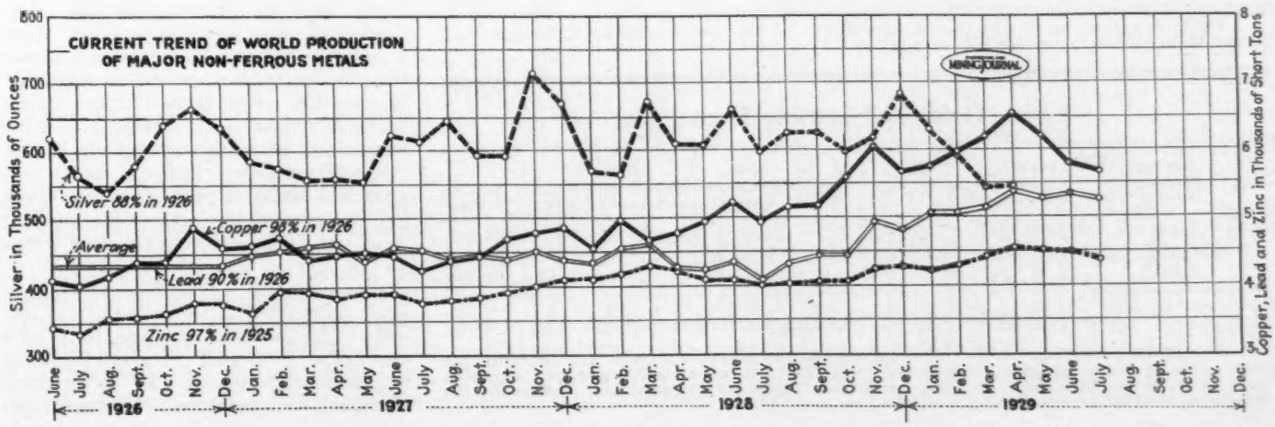








THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926, and accordingly the horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88% in 1926
Copper 93% in 1926
Average
Lead 90% in 1926
Zinc 97% in 1925
June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1926
1927
1928
1929

The Market Report

Lead Sales Near Record; Copper Much Quieter

New York, Sept. 11, 1929.—The phenomenal market in copper proved to be short-lived, sales in the week ending today being only about normal, and at unchanged prices. The higher prices and heavy demand for lead have easily been the feature of the non-ferrous metal market. Zinc and tin have been even quieter than they have in recent weeks, but it is thought that consumers of these metals are underbought and that a satisfactory market can be expected soon. Silver prices have weakened to 51⅜c., which is as low as they have been in thirteen years. The minor metals are unchanged.

Daily Prices of Metals

Sept.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
5	17.775	45.875	6.90	6.70	6.80
6	17.775	45.625	6.90	6.70	6.80
7	17.775	45.625	6.90	6.70	6.80
9	17.775	45.50	6.90	6.70	6.80
10	17.775	45.375	6.90	6.70	6.775@6.80
11	17.775	45.375	6.90	6.70	6.775@6.80
	17.775	45.563	6.900	6.700	6.796

Average prices for calendar week ending Sept. 7, 1929, are: Copper, 17.775; Straits tin, 45.700; New York lead, 6.850; St. Louis lead, 6.648; zinc, 6.800; and silver, 52.025.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic bid	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
5	77 7/8	79	84 1/2	206 3/4	210 3/4	23 5/8	23 5/8	24 13/16	25 3/8
6	76	77	84 1/2	205	209 3/4	23 5/8	23 5/8	24 3/4	25 5/16
9	76 1/16	76 7/8	84 1/2	205 1/4	209 1/4	23 1/2	23 3/4	24 1/2	25 1/16
10	75 5/8	76 5/16	84 1/2	204 1/4	208 3/4	23 5/16	23 9/16	24 3/8	24 7/8
11	76 3/16	76 1/2	84 1/2	204 1/4	208 1/4	23 7/16	23 5/8	24 3/8	24 7/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
5	4.84 1/2	52 1/8	24 1/8	84s11½d	9	4.84 3/16	51 3/8	24	84s11½d
6	4.84 3/16	51 3/4	24	84s11½d	10	4.84 3/16	51 5/8	24	84s11½d
7	4.84 3/16	51 5/8	24 1/16	. ..	11	4.84 3/16	51 5/8	23 13/16	84s11½d

Average: Silver, 51.792; Sterling Exchange, 484.198

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Still 18c.

When consumers found last week that a sustained effort was being made by most sellers to keep the copper market at 18c. a pound, for Connecticut deliveries, and that large supplies of the metal were being offered at that level, their demands moderated considerably, with the result that in the week ending today, sales have been only a little over 11,000 tons, in the domestic market. This is considered satisfactory business, however, and producers would generally prefer to see buyers enter the market for reasonable tonnages rather than to stampede as they did a week ago. Recently there have been more sellers at the 18c. level, though it is not yet possible to buy from every producer at that figure, and should another huge buying wave appear it is by no means certain that the price would not advance.

Most of the demand has been for either October or November shipment, though prompt is still requested in some instances and some buyers wish deliveries up to the end of the year. One sale, in fact, ran into January. Business was well distributed among the various classes of buyers, rather than confined to a few large orders.

Statistics on stocks at the end of August, which will be issued later in the week, are expected to show a slight increase in the amount of refined copper on hand as August shipments were not so large as they will be for September or October. Cessation of all work at the Chrome refinery on account of labor trouble will hold up shipments temporarily but it is expected that the refinery will be functioning regularly again in a day or two.

Foreign demand has been very satisfactory so far this month, all the principal European countries taking more than their quotas. The price continues at 18.30c., c.i.f.

Lead Active at 6.90c.

Last Thursday, Sept. 5, American Smelting & Refining advanced its contract price for lead to 6.90c., New York, and the sellers in the Middle West went to 6.70c., St. Louis, which levels have been maintained in practically all sales made since that time. The advance stimulated demand rather than stifled it, for consumers evidently feared that even higher prices might be quoted later. As a result of heavy purchases made throughout the week, the total reported business again approached 10,000 tons as it did the week before last. This makes the current week one of the three most active weeks of the year in lead.

Demand was general and ranged from numerous carloads to quite a few orders for several hundred tons, and one for a thousand. Though most of the carload business was for prompt shipment, October shipment was in de-

mand by the larger buyers, and an occasional request was made for November. Sellers of chemical lead are not inclined to book much October business, however, and October is as far as holders of desilverized lead care to venture as a general rule.

London prices have shown little variation since the advance here.

Zinc Demand Drops

Though the zinc market has not been active for many weeks, it was even duller this week than usual, sales being confined to only a few hundred tons. The general price level continues at 6.80c., St. Louis, but as a small tonnage has been sold for 6.775c. in the last two days, this level must be reflected in the quotation. It seems probable that the 6.80c. price will continue to be maintained, however, as fundamental statistics show that buying cannot be postponed much longer, and production is being cut.

August statistics issued by the American Zinc Institute, in tons of 2,000 lb., follow:

Stock, Aug. 1	44,122
Produced	55,290
Shipped	51,579
Stock, Aug. 31	47,833
Shipped from plants for export	969
Total retort capacity, Aug. 31	119,617
Average number retorts operating in August	73,602
Retorts operating Aug. 31	58,800

No Interest in Tin

Neither dealers nor consumers have been interested in tin this week, and the market has been a dull affair. Prices have shown only slight variation.

Silver Lower

During the last week the silver market has been quiet, with a downward tendency. At the close today, London touched a new low since October, 1915, and the New York market remained unchanged at 51⅝c., with a good demand at the price. Reports from abroad indicate sales by both India and China. The local market closes quiet and steady.

Mexican Dollars (Old Mexican pesos): Sept. 5, 39½c.; 6, 39¼c.; 7, 39⅜c.; 9, 39¼c.; 10 and 11, 39⅛c.

Foreign Exchange

Closing cable quotations on the leading European exchanges on Tuesday, Sept. 10, follow: Francs, 3.91⅞c.; lire, 5.22⅞c.; and marks, 23.805c. Canadian dollars, ⅜ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8¼c. per lb. for spot and future shipments, market steady. Cookson's "C" grade, spot, 14c., market quiet.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.80 and up.

CADMIUM — Per lb., New York: 80@90c. Active demand.

IRIDIUM — Per oz., $230@$240 for 98@99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, $68 per oz. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $125. Market firm. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of Sept. 7.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.75@$16.00 for future shipment. Offerings are not large, but with supplies for shipment from China somewhat freer, the tone in some quarters is slightly easier. Bolivian scheelite is held at $16. Western scheelite quoted at $16.50@$17 for October-November delivery.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the Sept. 7 issue.

Tri-State Production Cut 8,200 Tons

Joplin, Mo., Sept. 7, 1929

Blende		Per Ton
High		$46.80
Premium blende, basis 60%..	$44.00	
Prime Western, basis 60%..	43.00@	44.00
Table concentrate, 60%.....	41.00@	43.00
Flotation concentrate, 60%..	39.00@	41.00
Average settling price.....		44.27

Galena		
High		88.70
Basis 80% lead.....	85.00@	87.50
Average settling price.....		86.49

Shipments for the week: Blende, 11,335; galena, 1,841; Value, all ores the week, $661,130.

A holiday week following Labor Day was observed by more than sixty of the large producing companies. This lowered the output 8,200 tons. The 11,335 tons shipped reduced the reserve stock of zinc concentrate more than 6,500 tons, leaving approximately 32,000 tons unsold in the bins. Restriction of output will continue throughout September by several companies that preferred closing one of a group of mines during the month to closing all for one week.

American Zinc Institute reports the retiring of 13,000 retorts at the end of August, which is equivalent to three smelters idle. A rumor, given credence as seemingly based on inside information, is to the effect that retort smelters will each dead fire one week during September, thus reducing the production of metal to the apparent demand.

A higher price for lead concentrate is reported.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Sept. 7 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Good call at steady prices.

SODIUM NITRATE — Per 100 lb., $2.08 for Sept. deliveries.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Sept. 7 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace on carload business.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45@$1.50, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the Sept. 7 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets, and Copper Wire, are unchanged from prices in the Sept. 7 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Sept. 7.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.65@$2.75. Connellsville foundry, $3.75@$4.75. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended September 7, 1929

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Anaconda Copper	New York	133⅜	127⅛	132⅛	Jl. 13, Au. 19 Q 1.75
Andes Copper	New York	60⅛	57	59⅛	Jl. 13, Au. 12 Q 0.75
Arizona Com.	Boston	2⅜	2⅛	2⅜	Jl. 16, Jl. 31 SA 0.25
Calumet & Aris.	New York	135	129½	130	Se.6, Se.23 Q 2.50
Calumet & Hecla	Boston	47½	45⅛	46⅜	Au.31,Se.30 Q 1.00
Cerro de Pasco	New York	104½	97⅛	103⅛	Jl.11, Au. 1 Q 1.50
Con. Coppermines	N. Y. Curb	10	8⅛	9	
Copper Range	Boston	26	25⅛	25⅛	Se.14, Oc.15 Q 0.50
East Butte	Boston	2⅛	2⅛	2⅛	Dec., 1919 0.50
Granby Con.	New York	86⅛	82⅛	84⅛	Jl.12, Au.1 Q 1.75
Greene Cananea	New York	200½	193	199	Se.12, Oc.7 Q 2.00
Howe Sound	New York	70⅜	67½	69⅜	Je. 29, Jl. 15 Q 1.50
Hudson Bay	N. Y. Curb	18⅜	17⅜	17⅜	
Inspiration	New York	49⅜	46⅜	49⅛	Se.9, Oc. 7 Q 1.00
Isle Royale	Boston	24½	23½	24	Au. 31, Se.30 0.50
Kennecott	New York	95	89⅜	95	Au. 30, Oc. 1 Q 1.25
Magma Copper	New York	77	73⅜	74⅜	Je.28, Jl.15 Q 1.25
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜	
Miami Copper	New York	47⅛	44⅛	47⅛	Au. 1, Au. 15 Q 1.00
Mohawk	Boston	64⅛	54⅛	62⅛	Jl. 31, Se. 2 Q 2.00
Mother Lode	New York	3	2⅛	2⅛	Je. 13, Je. 29 0.20
Nevada Con.	New York	54⅜	48⅛	54⅛	Je. 14, Je. 29 Q 0.75
Noranda	N. Y. Curb	65⅛	63	63⅛	
Ohio Copper	N. Y. Curb	1⅜	1⅛	1⅛	Sept., 1926 0.03
Old Dominion	Boston	10	9⅛	9⅛	Dec., 1918 1.00
Phelps Dodge	New York	68⅞	60	68	Se. 4, Oc.1 Q 0.75
Quincy	Boston	49	47	48	March, 1920 1.00
Roan Antelope	N. Y. Curb	49⅛	47⅛	49⅛	
St. Mary's M. L.	Boston	42	40	40⅜	Fe.25, Mr.12 2.00
Seneca Copper	New York	5⅛	5⅛	5⅛	
Shattuck Denn	N. Y. Curb	17	16	16⅛	
Sherritt-Gordon	Toronto	7.40	7.10	7.20	
Tenn. C. & C.	New York	19⅛	17⅜	19⅛	Au.31, Se.16 Q 0.25
United Verde Ex.	N. Y. Curb	17⅜	17⅛	17⅜	Jl. 2, Au. 1 Q 1.00
Utah Copper	New York	325	325	325	Je. 14, Je. 29 Q 4.00
Waite-Ack.-Mont.	Toronto	6.75	6.35	6.50	
Walker Mining	Salt Lake	5.75	5.70	5.70	
Wenden Copper	N. Y. Curb	1⅛	1	1⅛	
LEAD, ZINC, SILVER					
Ahumada Lead	New York	1⅜	1⅛	1⅛	
Amer. Z. L. & S.	New York	27⅜	24⅜	25	May, 1917 1.00
A. Z. L. & S., pfd.	New York	107⅜	104½	105⅛	Je.14, Jl. 1 1.50
Bunker Hill & S.	N. Y. Curb	143	143	143	Au.22, Se.5 X 0.75
Butte Cop. & Zn.	New York	4⅛	4⅛	4⅛	
Butte Cop. Con.	Boston Curb	*31⅛	*25	*31⅛	
Butte & Sup.	New York	8⅛	8	8⅛	Je. 14, Je. 29 Q 0.50
Callahan Zn-Ld.	New York	2	1⅛	1⅛	Dec., 1920 0.50
Chief Consol.	Salt Lake	3.50	3.45	3.50	Fe. 1, 1928 K 0.10
Consol. Ld. & Zn. "A"	St. Louis	11⅛	10⅜	10⅜	Je.20, Jl.1 Q 0.25
Constitution	Spokane	*50	*45	*45	
Dayrock	Spokane	3.25	3.25	3.25	Je.20, Je.30 0.03
Dickens Consol.	Spokane	*7⅛	*6⅛	*7⅛	
Eagle-Picher	Cincinnati	17⅛	16⅛	17⅛	Je. 30, Jl.15 Q 0.20
Eagle-Pich., pfd.	Cincinnati	...	...	103	Je. 30, Jl. 15 Q 1.50
Erupcion	Boston Curb	...	...	*12	Ja. 1, 1928 Q 0.07½
Eureka Bullion	Salt Lake	1.05	1.00	1.05	
Eureka Lily	Salt Lake	...	...	*33	
Eureka Standard	Salt Lake	...	...	1.42½	
Evans-Wallower	N. Y. Curb	17½	16½	17½	
Evans-Wal., pfd.	N. Y. Curb	...	...	84	Je.20, Jl. 1 Q 1.75
Federal M. & S.	New York	....	....	280	Je., 1927 10.00
Fed. M. & S., pfd.	New York	...	...	99⅛	Au.23, Se.16 Q 1.75
Gladstone	Spokane	*5	*4	*4	
Goldonda	Spokane	*76	*70	*74½	Je.15, Jl.1 0.02
Grandview	Spokane	*34½	*32½	*32½	
Hecla Mining	N. Y. Curb	17⅞	17⅛	17⅛	Au.15,Se.15 Q 0.25
ghland-Surprise	Spokane	*15½	*15	*15	
Jack Waite	Spokane	*8⅛	*8	*8	
Kootenay Florence	Spokane	*14	*12½	*14	
Lucky Jim	Spokane	*9⅛	*9	*9	
Lucky Tiger-C.	Kansas City	†3.00	†2.87½	...	Au. 1, Au. 10 0.02½
Mexican Premier	Spokane	2.26	2.22	2.23	
National Lead	New York	170½	162	170½	Se. 13, Se. 30 Q 1.25
Natl. Lead, pfd. A	New York	139	139	139	Au.30, Se. 14 Q 1.75
Natl. Lead, pfd. B	New York	116	116	116	Oc. 18, No. 1 Q 1.50
N. J. Zinc, new	N. Y. Curb	85	84½	85	Jl.20, Au.10 Q 0.50
New Quincy	Salt Lake	2.45	2.37½	2.42½	My.15, My.27 Q 0.10
Noble Five	Spokane	*56	*54	*55	
North Lily	Salt Lake	6.25	6.00	6.20	Jl.16, Jl.20 Q 0.25
Park Bingham	Salt Lake	7.00	6.00	7.00	
Park Utah	New York	6⅛	5⅞	6	Je. 14, Jl. 10 Q 0.20
Pend Oreille	Spokane	5.00	5 50	4.75	
Rico Argentine	Salt Lake	*32	*32	*32	No. 30, De. 15 Q 0.03
Ruth-Hope	Spokane	*34	*34	*34	
St. Joseph Lead	New York	72⅜	68½	71	Se.10,Se.20 QX 0.75
Sherman Lead	Spokane	*66½	*65	*65	
Silver King Coa.	Salt Lake	12.75	12.50	12.75	Se. 20, Oc. 1 0.25
Silversmith	Spokane	*8⅛	*7½	*8½	Oct., 1926 Q 0.02
Sunshine Mining	Spokane	6.75	6.35	6.75	Je. 10, Je. 20 Q 0.05
Tamarack-Custer	Spokane	*74	*65½	*65½	Sept., 1924 0.25
Tintic Standard	Salt Lake	13.75	13.62½	13.62½	Se. 17, Se.20 X 0.30
Tonopah Belmont	N. Y. Curb	*.50	*.50	*.50	Oct., 1925 0.05
Treadwell-Yukon	Toronto	9.60	9.00	9.25	
United Zinc Smg.	N. Y. Curb	...	...	*68⅜	
Utah Apex	Boston	3⅞	3⅜	3⅜	May 15, June 1 0.25
Utah Met. & Tun.	Boston	1⅛	1	1⅛	Dec., 1917 0.30
Whitewater	Spokane	*50	*50	*50	
Yellow Pine	Los Angeles	..	....	*8	Dec., 1925 QX 0.04
GOLD					
Alaska Juneau	New York	8⅛	8⅛	8⅛	
Barry-Hollinger	Toronto	*28	*22	*24	
Central Manitoba	Toronto	*40	*30	*32	
Cresson Consol.	N. Y. Curb	*56½	*37½	*50	Se.30, Oc.10 Q 0.02
Dome Mines	New York	10	9⅛	10	Jl. 20, Q 0.25
Golden Cycle	Col. Springs	†1.75	†1.72	....	Au.31,Se.10 Q 0.04
Hollinger	Toronto	6.25	6.50	5.90	Au.23,Se.9 FW 0.50
Homestake	New York	80	80	80	Au.20, Au.26 H 0.50
Kirkland Lake	Toronto	*70	*58	*65	
Lake Shore	Toronto	24	20⅜	24	Je.1, Je.15 Q 0.20
McIntyre-Poro	New York	15⅜	14⅛	14⅛	Au.1, Se.2 Q 0.25
Portland	Colo.Springs	†*6	†*5½	.....	April, 1927 0.02
Rand Mines	New York	35⅛	32	35⅛	Au. 21,'29 Am.Sh.1.51
Siscoe	Toronto	*95	85	90	
Sylvanite	Toronto	*85	*85	*85	
Teck-Hughes	Toronto	6.50	5.20	6.35	Jl. 18, Au. 1 0.15
Tom Reed	Los Angeles	*70	*65	*68	Dec., 1926 0.02
Unity Gold	N. Y. Curb	1⅜	1⅛	1⅛	
Vipond Consol.	Toronto	*80	*75	*75	April, 1927 0.03
Wright-Hargreaves	Toronto	1.61	1.41	1.61	Oc. 16, No. 1 0.02½
Yukon-Alaska	N. Y. Curb	....	....	35⅛	
GOLD AND SILVER					
Carnegie Metals	N. Y. Curb	20	17	17⅜	
Castle-Trethewey	Toronto	*30	*30	*30	
Consol. Cortes	N. Y. Curb	...	...	*6½	
Dolores Esperanza	N. Y. Curb	*50	*50	*50	July, 1923 0.05
Keeley	Toronto	*46	*44	*44	Mr.15, 1928 0.04
Mining Corp.	Toronto	4.25	3.70	4.20	My.30, Je.13 0.12½
Montana-Idaho	Spokane	*8⅛	*7⅛	*8	
N. Y. & Hond. Ros.	N. Y. Curb	....	....	16	Jl.17, Jl.27 QX 0.50
Nipissing	N. Y. Curb	2⅛	2	2⅛	Se.30, Oc.21 0.07½
Premier Gold	N. Y. Curb	1⅞	1⅛	1⅞	Se.12, Oc.3 0.06
Tonopah Exten.	N. Y. Curb	....	....	*10	April, 1925 0.05
Tonopah Mining	N. Y. Curb			2⅛	Ap. 7, Ap. 20 0.07½
United Eastern	N. Y. Curb	*43⅛	*31⅛	*43⅛	
Yukon Gold	N. Y. Curb	*68⅛	*62⅛	*62⅛	June, 1918 0.02
IRON AND STEEL					
Bethlehem Steel	New York	140⅛	129	134	Oc. 18, No. 15 Q 1.50
Beth. Steel, pfd, 7%.	New York	123⅜	121	122⅛	Se.6, Oc.1 Q 1.75
Cleveland-Cliffs	Cleveland	97⅛	96⅛	97⅛	Se. 5, Se.15 Q 1.00
Colo. Fuel & Iron	New York	66⅛	61	63	
Colo. F. & I., 1st pfd.	New York	...	...	133	Au.10, Se.26 Q 2.00
Great Northern Iron	New York	31⅛	29⅛	30⅛	Dec.15, K 2.00
Inland Steel	New York	107	101	105⅛	Au.15, Se. 1, Q 1.87½
Republic I. & S.	New York	129⅛	121⅛	125⅛	My. 11, Je. 1, Q 1.00
Republic I. & S., pfd.	New York	112	111⅛	112	Je .12, Jl. 1, Q 1.75
Sloss-Sheffield S. & I.	New York	51	48	48	Mr. 11, M-. 20, Q 1.50
Sloss-Sheff. S. & I., pfd.	New York	70⅛	68	70⅛	Se.20, Oc.1, Q 1.50
U. S. Steel	New York	261⅛	245⅛	247⅛	Au. 29, Se. 28, Q 1.75
U. S. Steel, pfd.	New York	144⅛	143	143	Au. 5, Au. 30, Q 1.75
Virginia I. C. & C.	New York	20	20	20	Jan., 1924 1.50
Virginia I.C.& C., pfd.	New York	42	40	40	Jl.16, 1928 SA 2.50
MISCELLANEOUS					
Aluminum Co. of Am.	N. Y. Curb	472	455	460	
Alum.Co.of Amer., pf.	N. Y. Curb	107⅛	107⅛	107⅛	Mr.15, Ap.1, Q 1.50
American Metal	New York	79⅛	72⅛	77⅛	Au. 21, Se. 1 Q 0.75
Amer. Metal, pfd., 6%	New York	132⅛	125	132⅛	Au. 21, Se. 3 Q 1.50
Amer. Sm. & Ref.	New York	130⅛	125	129	Je. 30, Jl. 12 Q 1.00
Amer. Sm. & Ref., pfd.	New York	134⅛	134⅛	134⅛	Au. 3, Se. 1 Q 1.75
Ang. Ch. Nitrate	N. Y. Curb	34⅛	33⅛	33⅛	
Asbestos Corp.	Montreal	9⅛	9⅛	9⅛	Jan. 1926 1.50
Asbestos Corp., pfd.	Montreal	30	30	30	De. 31, Ja. 15 Q 1.75
Consol. M. & S.	Montreal	450	428	430	Je.29,Jl.15, SA X6.25
De Beers Consol.	New York	23⅛	21	23⅛	Jl. 23, Jl.26, Q 0.96
Federated Metals	N. Y. Curb	37	34⅛	37	Je.25, Jl.5 Q 0.75
Freeport Texas	New York	51⅛	48	49⅛	Jl. 5, Au.1 Q 1.00
Int. Nickel Can.	New York	55⅛	52⅛	53⅛	Au.31, Se.30 Q 0.25
Int. Nickel, pfd.	New York	...	...	122⅛	Jl.1, Au.1 Q 1.75
Mayflower Assoc.	N. Y. Curb	93	9⅛	93	
Metal & Mining	N. Y. Curb	20	19⅜	19⅜	Je.20, Jl.1 Q 0.30
Newmont	N. Y. Curb	223⅛	222	227⅛	Je.29, Jl.15 Q 1.00
Patiño M. & E.	New York	41⅛	40⅛	41	Au.31,Se.28,Am.Sh.0.97
So. America G. & P.	N. Y. Curb	2	2	2	
Texas Gulf Sulphur	New York	72⅛	70⅛	71	Se.2, Se.16 Q 1.00
U. S. Sm. R. & M.	New York	55⅛	53⅛	53⅛	Jl. 5, Jl. 15 Q 0.87½
U. S. Sm. R. & M., pfd.	New York	52⅛	52	52⅛	Jl. 5, Jl. 15 Q 0.87½
Vanadium Corp.	New York	88	80⅛	87⅛	Au.1 Au. 15 Q 0.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumption. X, Extra. The first date given is that of the closing of the books: the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED August 28, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	55/—	55/—	55/—	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	60/—	58/—	60/—	Aug., 1929	5 p.c.
Burma Corp (10 rupees)	18/1½	17/3	18/—	July 1929	9 annas*
Bwana M'Kubwa (5s)	29/10½	26/7½	28/10½		
Camp Bird (2s)	2/3	1/9	2/3	April, 1928	16⅔ p.c.
El Oro (5s)	2/9	2/4½	2/9	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	6/10½	6/10½	6/10½	Jan., 1929	3¾ p.c. (e)
Mexican Corpn. (£1)	16/6	15/7½	16/3		
Mexico Mines of El Oro (£1)	5/—	3/9	5/—	Dec., 1926	3¾ p.c.*
Mount Isa (£1)	41/9	39/—	41/3		
N'Changa Copper Mining. (£1)	77/9	70/—	75/—		
Oroville Dredging (4s)	2/—	2/—	2/—	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	228/9	210/—	222/6		
St. John del Rey (£1)	15/10½	15/—	15/6	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	36/3	34/—	34/9	June 1929	15 p.c.
Santa Gertrudis (£1)	9/9	9/3	9/6	July 1929	7½ p.c.
Selukwe (2s. 6d.)	6/—	5/6	5/9	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/1½	2/10½	2/10½	Nov. 1917	75 p.c.
Tanganyika (£1)	64/—	60/—	61/10½	July, 1928	5 p.c.
Union Miniere du Haut-Katanga (Brussels)	11,890	11,525	11,775	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation. (d) U. S. Dollars. (e) July, 1929, ex ½d. return of capital. (e) on original £1 shares.